SCIENCE

FRIDAY, JUNE 11, 1915

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MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

BEFORE AND AFTER LISTER[1]

LECTURE I, "BEFORE LISTER"

ON July 1, 1861, I entered the service of the State of Massachusetts as assistant surgeon of the Fifth Massachusetts, and on July 4 was sworn into the service of the United States in the shadow of yonder capitol. On August 1 I was honorably discharged and resumed my medical studies at the Jefferson Medical College. Strange as it now seems, when assistant surgeon I was not yet a graduate in medicine. As an evidence of the loose way in which medical and military matters were then conducted, I was actually appointed without any examination whatever.

After graduating in March, 1862, I again entered the service in May, after an examination, and was ordered to the Eckington Hospital in the then outskirts of Washington. Shortly afterwards I was ordered to fit up two churches as hospitals and to have them ready in five days. It was 5 P.M. on a Saturday afternoon.

People sometimes imagine that a practising physician can be transformed into an army surgeon merely by putting a uniform on him. I was not lacking in ordinary intelligence and was willing to work, but I was utterly without training. To get those two churches ready as hospitals I had to have beds, mattresses, sheets, pillow-cases, chairs, tables, kitchen utensils, knives, forks, spoons, peppers and salts, all sorts of crockery and other necessities for a dining-room, all the drugs, appliances and instruments needed for two hundred sick and wounded men; I needed orderlies, cooks and the endless odds and ends of things which go to make up a well-organized hospital. I did not know how to get a single one of these requisites. As to drugs, I did not know whether

[1] Two lectures before the U. S. Army Medical School, Washington, D. C., April 27 and 28, 1915.

to order six ounces or a gallon of laudanum, an ounce or two or a pound or two of opium, and I was in utter darkness as to the mode of getting any of the other things from a teaspoon to a cook. However, I inquired and as soon as I learned how, I set myself to work. For two nights I slept only about three hours each, and I had the satisfaction of reporting to Dr. Letterman at the end of three days, instead of five, that I was ready. On the fourth day I had one hundred wounded men in each hospital.[2]

I congratulate you in this more enlightened age and as students in this fine school where you are trained and drilled in matters which we had to cope with in our stumbling way, by dint of desperately hard work, without guidance, often learning only by our bitter mistakes.

We, the few surgeons still surviving those momentous four years, may well say to you *Morituri salutamus.*

I have been so very fortunate as to live during the whole period of the greatest revolution surgery has ever passed through. How strange seem these words of Erichsen, the then foremost London surgeon and Lister's early chief at University College Hospital uttered in 1874, just as surgery was on the eve of its very greatest triumph.

Surgery in its mechanical and manipulative processes, in its art in fact, is approaching, if it has not already attained to, something like finality of perfection.[3]

Anesthesia in 1846 and 1847 had robbed operations of the terror of agonizing pain. Quick, "slap-dash surgery"—a necessity before the days of anesthesia—then gave way to delicate, painstaking, artistic surgery. Antiseptics thirty years later relieved the patients from the terrors of death and gave to the surgeon restful nights and joyous days.

Hence when I received the kind invitation to address you it seemed to me that I could possibly render you some service by describing the state of surgery "Before and After Lister," since my testimony would be that of an eye witness.

When the Apostle Paul was about to be bound and scourged you remember that he claimed immunity as a Roman. "With a great sum obtained I this freedom," explained the chief captain. "But I," said the Apostle, with justifiable pride, "was free born." "With a great sum" of the most strenuous labor the men of my generation acquired the knowledge and the skill and the immense satisfaction of the antiseptic and aseptic era—but you, you are "free born" and have entered into a rightful heritage from your fathers. "Before Lister" and "After Lister" in the surgical calendar are the equivalents of "B.C." and "A.D." of our common chronology.

Modern military surgery may be said to begin with Ambroise Paré in the middle of the sixteenth century. Gunpowder, though long known, had been used in warfare to any large extent for only a few decades. The belief, shared fully by Paré himself, that such wounds were "poisoned," was universal. Treatment was directed to the destruction of the supposed poison by pouring boiling oil and hot pitch into such wounds. In the heat of his anger at the inhumanity of the new weapons he says in his preface to Book XI., "Of wounds made by gunshot and other fiery Engines and all sorts of Weapons":[4]

I think the deviser of this deadly Engin hath this for his recompence that his name should be hidden by the darkness of perpetual ignorance as not meriting for this his most pernitious Invention Any Mention from Posterity.

Yet with a curious inconsistency he immediately gives the name of a German monk as the "deviser."

[2] Keen, "Addresses and Other Papers," 1905, p. 424.

[3] Wrench, "Lister's Life and Work," p. 281.

[4] "The Works of that Famous Chirurgeon Ambrose Parey," translated by Th. Johnson, London, 1678, p. 270.

Listen to his quaint story of how he discovered that gunshot wounds were *not* poisoned. In 1536

it chanced on a time that by reason of the multitude that were hurt I wanted this Oil ["oyl of Elders Scalding hot with a little Treacle mixed therewith"]. Now because there were some few left to be dressed I was forced . . . that I might not leave them undrest to apply a digestive made of the yolk of an egg, Oil of Roses and Turpentine. I could not sleep all that night for I was troubled in mind, and the dressing of the precedent day (which I judged unfit), troubled my thoughts; and I feared that the next day I should find them dead, or at the point of death by the poison of the wounds. . . . Therefore I rose early in the morning. I visited my Patients and beyond expectation I found such as I had dressed with a digestive only, free from vehemency of pain, to have had a good rest and that their wounds were not inflamed . . . but . . . the others that were burnt with the Scalding Oyl were feverish tormented with much pain . . . and swoln. When I had many times tried this in divers others, I thought this much, that neither I nor any other should ever cauterize any wounded with Gunshot.[5]

But he still advocated the actual cautery for arresting hemorrhage even down to early in 1552. But later in that same year he changed his practise and thus describes his introduction of the ligature—a famous advance.

I confess here freely and with great regret that heretofore my practise has been entirely different from that which I describe at present after amputations. . . . I advise the young surgeon to abandon such cruelty and inhumanity and follow this better method. . . . Having several times seen the suture of veins and arteries for recent wounds which were attended by hemorrhage I have thought that it might be well to do the same after the amputation of a limb. Having consulted in reference to this matter with Etienne de la Rivière, Ordinary Surgeon to the King, and other surgeons sworn of Paris, and having declared my opinion to them, they advised that we should make the experiment [espreuve] on the first patient that we had, but [note his cautious uncertainty] but we would have the cautery all ready in case of any failure of the ligature. I have done this on the person of a postilion named Pirou Garbier, whose right leg I cut off . . . following a fracture.[6]

At the Siege of Danvilliers[7] also in 1552 he records the amputation of the leg of a gentleman in the suite of M. de Rohan "without applying the actual cautery." In another place[8] Paré says that he was taught this new method "by the special favor of the Sacred Deity." He also refers to Galen's advocacy of the ligature. After many trials, Paré definitely adopted the ligature and "bid eternal adieu to all hot Irons and Cauteries."

He does not seem to have lost sleep over the ligature as he did sixteen years before when he abandoned the boiling oil and the hot pitch. Both were experiments on human beings. "Human vivisection" would have been the outcry of a sixteenth-century antivivisection society. But had he or some successor *not* made these experiments we should still be filling gunshot wounds with boiling oil and hot pitch and searing amputation flaps with the actual cautery. How much greater a boon to humanity it would have been if years earlier instead of experimenting in both cases on human beings first, Paré had experimented on a few animals to determine whether gunshot wounds *were* poisoned and whether the ligature or the cautery *was* the best means of arresting hemorrhage.

We can also incidentally learn how the doctrine of euthanasia was applied in Paré's time in the case of the desperately wounded by the following incident.

In his first campaign, entering a stable where he expected to put up his own and his man's horses, Paré

[5] Johnson's "Paré," p. 272.

[6] Malgaigne's "Paré," Chap. XXVI., pp. 227, 230.

[7] Malgaigne's "Paré," III., 698.

[8] Johnson's "Paré," London, 1678, Book XII., Chap. XXIV., p. 305.

found four dead soldiers and three propped against the wall, their features all changed, and they neither saw, heard nor spake, and their clothes were still smouldering where the gun-powder had burnt them. As I was looking at them with pity there came an old soldier who asked me if there was any way to cure them. I said no, and then he went up to them and cut their throats gently and without ill will toward them.[9]

Leaping over three and a half centuries of only moderate progress, let us next consider the state of surgery a hundred years ago. No better representative perhaps could be chosen than John Bell, the professor of surgery in Edinburgh, whose "Discourses on the Nature and Cure of Wounds" had reached a third edition in 1812, and his "Principles of Surgery" a new edition in 1826, to which his brother, Sir Charles Bell, also contributed.

In the former he states that tents or setons were much in use and the surgeons "were quite delighted with seeing prodigious quantities of matter spouting out when they drew their spigot away" (p. 299).

As to abdominal wounds he says:

Having put it down as a prognostic, which is but too well confirmed, by much melancholy experience, that wounds of the belly are mortal, there is no reason why we should, in recording our cases, take any note of a man having died after such a wound. Death from such a wound is a daily and expected occurrence and, therefore, is not marked; but if we find that a man has escaped, are we not to record every such escape? (p. 313).

Per contra, to-day recovery has been achieved after 19 wounds of the abdominal viscera!

He considers wounds of the joints also as mortal, and amputations even in the most favorable circumstances did not heal under four, five or six months!

In his "Principles of Surgery"[10] he pictures the wards of a hospital as follows: You look

upon limbs variously wounded, but all of them lying out, swollen, suppurating, fistulous, rotting in their own filth, having carious bones, bleeding arteries and a profusion of matter; the patients exhausted in the meanwhile, with diarrhea, fever and pain.

Again he refers to a wounded limb as "soaking in suppuration" and again, of its "lying in a slush of matter and foul poultices."

He relates the case of an officer under the care of Guérin, a French surgeon. He was wounded by a ball which had broken the fifth rib twice and traversed the entire chest. After dilating the wounds, Guérin introduced a seton ["a great strap of coarse linen"],

which, of course, went across the breast as a bow-string crosses a bow, and this seton he continued to draw with a perseverance which is truly wonderful from the first day to the thirty-eighth day of the wound; during all of which time the patient's sufferings were dreadful (p. 458).

In fifteen days the patient was bled twenty-six times. After the removal on the thirty-third day of a splinter of bone, which had been imbedded in the lung, the patient, strange to say, recovered both from the wound and from the surgeon. It is not to be wondered at that Bell condemns such treatment. But it existed in the practise of reputable surgeons.

Erysipelas, tetanus, pyemia, septicemia were rife. Hospital gangrene was endemic in many if not most hospitals, due to inevitable infection in practically every wound. Veritable epidemics were frequent. Is it any wonder that it had always been present for nearly two hundred years in the Hôtel Dieu in Paris when there were often from two to six patients (and such patients!) in one bed? Passing along the streets of Paris even during the Crimean War[11] "one could

[9] Paget's "Ambroise Paré," p. 31.

[10] John Bell's "Principles of Surgery," new edition, with comments by Charles Bell, London, 1826, p. 86.

[11] Wrench's "Life of Lord Lister," p. 239.

recognize at a distance a surgical hospital owing to the stench of the human putridity it contained." In the surgical wards, "no matter how well ventilated, there was a fetid sickening odor" up to the days of Lister himself, wrote Sir Hector Cameron, Lister's house surgeon in Glasgow. Death always stalked grimly behind the surgeon.

> Secondary hemorrhage, tetanus, erysipelas, septicemia, pyemia and hospital gangrene were never all absent . . . and at times pyemia and hospital gangrene became alarmingly epidemic.[12]

After vividly describing the ravages of hospital gangrene Bell then vehemently asks:

> What, then, is the surgeon to do? Is he to try experiments with ointments and plasters while the men are dying around him? Is he to seek for washes and dressings to cure such a disease as this? Is he to expend butts of wine contending, as it were, against the elements? No! Let him bear this always in mind, that no dressings have ever been found to stop this ulcer, that no quantities of wine or bark which a man can bear have ever retarded this gangrene; let him bear in mind that this is a hospital disease, that without the circle of the infected walls the men are safe; let him, therefore, hurry them out of this house of death; let him change the wards, let him take possession of some empty house and so carry his patients into good air; let him lay them in a schoolroom, a church, on a dunghill, or in a stable; let him carry them anywhere but to their graves.[13]

To-day we do not even know the bacteriology of this foul disease. I saw many cases of it during the Civil War, but since 1865 I have never seen a single case. There has been no opportunity to discover its germ if, as is probable, it is a germ disease. Lister made its return impossible.

But let us come down next to the period immediately before Lister's work.

You can not do better than read that remarkable and revolutionary paper entitled "Hospitalism" by Sir James Y. Simpson, of Edinburgh, published in 1867.[14] It was a bombshell whose explosion aroused the profession as hardly any other paper in my lifetime. The controversy was bitter and widespread. Fortunately, antisepsis came close upon its heels and has forever done away with such a disgrace.

Simpson collected the statistics of the obstetrical mortality in hospitals and in homes with the following startling result.

> Of 888,302 women delivered in hospitals, 30,394 died or 1 in 29—3.4 per cent.
>
> Of 934,781 delivered at home, 4,045 died, or 1 in 212—0.47 per cent.

The reason for the greatly increased mortality in maternity hospitals—over seven times greater than in individual homes—was chiefly puerperal fever. After Oliver Wendell Holmes (1843) and Semmelweiss (1861) had attacked the evil, Pasteur finally in 1879 showed its bacteriological cause and gave it the *coup de grâce*.

The 0.47 per cent. of Simpson's home cases has been reduced to 0.15 per cent. and even 0.08 per cent. in the maternity hospitals of to-day.

But his chief assault was upon the surgeons. He analyzed the four main amputations—arm, forearm, thigh and leg—and excluded amputations at joints and all the minor amputations (fingers, toes, etc.).

> Of 2,089 such amputations in hospitals, 855 died, or 41 per cent.
>
> Of 2,098 in country practise, 222 died, or 10.8 per cent.

The latter were collected from 374 country practitioners, thus eliminating the personal equation. The difference was clearly due to the crowding and lack of sanitation in the hospitals of that day.

He gives two very interesting tables. The first is most instructive in showing the

[12] Cameron, *British Medical Jl.*, Dec. 13, 1902, p. 1844.

[13] Bell, "Principles of Surgery," 1826, I., p. 149.

[14] Simpson's Works, Vol. II., p. 345.

results in the then unsanitary state of all hospitals.

Mortality After the Four Selected Amputations in Proportion to the Number of Beds in the Hospitals

In the large Parisian hospitals	62 in 100 die
In British hospitals with 300 to 600 beds	41 in 100 die
In British hospitals with 300 to 201 beds	30 in 100 die
In British hospitals with 200 to 101 beds	23 in 100 die
In British hospitals with 100 to 26 beds	18 in 100 die
In British hospitals with 25 beds or less	14 in 100 die
In isolated rooms in country practise.	11 in 100 die

In the second he tabulates the mortality according to the experience of the operator.

Death Rate After the same Four Amputations in Accordance with the Experience of the 374 Operators

Those who had done less than 6 amputations	lost 1 in 7
Those who had done from 6 to 12 amputations	lost 1 in 9
Those who had done 12 or more amputations	lost 1 in 12

What an argument for the necessity for a year in a hospital for the recent graduate before allowing him full liberty of action!

In France matters were as bad if not even worse. T. Holmes and Bristowe in 1861 had found that in Paris, of 102 of the four amputations in question, 67 died, a mortality of 65.7 per cent., or two out of every three. Out of 1,656 amputations in the Paris hospitals collected by Malgaigne and Trélat 803 died, 48.5 per cent., almost one in every two (Simpson, p. 291).

To-day, how entirely changed is all this. Listerism has transformed what Bell well called "Houses of Death" into "Havens of Safety." No home, however wealthy its inmate, can be as sanitary, as surgically clean or give as good results as a modern hospital.

The best evidence of the truth of this statement I can give you is the statistics of Dr. W. L. Estes,[15] of South Bethlehem, Pennsylvania. They are of especial value in that they are the statistics of the same surgeon in the same hospital and on the same class of patients. He reports the result in 724 major amputations. In 616 single amputations there were 28 deaths, a mortality rate of 4.54 per cent. Of 469 of the four selected amputations, 25 died, a mortality of 5.3 per cent. Of synchronous double, triple and one quadruple amputation, many of them complicated with other wounds and operations, there were 108, with 19 deaths, a mortality of only 18 per cent. It is very noticeable that in an earlier paper in 1894 in which he had reported the first 46 cases of synchronous double, triple and quadruple and complicated amputations, there were 13 deaths, 28.3 per cent., whereas from 1894 to 1913 in the last 62 such cases there were only six deaths, a mortality of 9.6 per cent., showing again the value of still larger experience even to an already experienced surgeon. In the second series there was no quadruple amputation.

But as officers of the Medical Corps of the Army you will be especially interested in the facts as to military surgery before and after Lister. Capt. Louis C. Duncan of our corps published a very interesting and comprehensive article[16] just before the present European war broke out.

He states that in Motley's "Rise of the Dutch Republic" in three volumes covering "30 years of almost constant sanguinary warfare" in the sixteenth century he "never once alludes to an army surgeon or an army hospital"! The surgeons were undoubtedly not officially attached to the army, but were in the suites of kings,

[15] *Annals of Surgery*, July, 1913.

[16] *Journal of the Military Service Institutions of the United States*, March–April, 1914.

princes or great nobles, as was Paré, in the same century.

To Sir James McGrigor in the Peninsular Campaign (1808–11) only fifty years before our Civil War, is given the credit by Duncan of first collecting accurate military medical statistics.

One hundred and fifty years ago 25 per cent. or more of the wounded died. In the Civil War and in the Franco-Prussian War of 1870–1 the rate had fallen to about 15 per cent., while to-day up to the present war not over 5 or 6 per cent. die of wounds.

The Crimean War will always be an example of utter inefficiency in the English and even worse in the French army. Its one bright spot is the splendid epoch-making work of a woman, Florence Nightingale, whose labors were unceasing and effective. Every war since then has seen less sickness and fewer deaths because of what she then accomplished.

Chenu, the French medical historian of that war, has made one curious and interesting calculation, partly official, partly estimated. The number of projectiles of all kinds actually fired he gives as 89,595,-363. The total number of killed and wounded was 175,057. This would show that it took 512 projectiles to kill or wound one man. Such a disproportion would more than justify a cartoon during our Civil War. Two soldiers were surprised by a hundred of the enemy. One proposed to the other to run for it. "No," was the cool reply, "There's no danger, for they say only one ball in 200 ever hits and there are only one hundred of those fellows."

Duncan's figures give 82,901 British soldiers sent to the Crimea, but the average strength was only 34,559, or only about 40 per cent., of effectives. The killed (2,755) and the deaths from wounds (2,019) gave a battle death rate of 69 per 1,000 per annum, while the disease death rate rose to 230 per 1,000 per annum.

In all, 300 men out of each 1,000 perished each year!

But the French statistics are still worse. While 315,000 were sent out, the average strength was less than 104,000 effectives, or only 33 per cent. The killed numbered 7,607 and the deaths from wounds 8,813. The battle death rate was 70, the disease death rate 341, per 1,000 per annum. Over 6,000 died from typhus alone.

Could there be a nobler example of the altruism of our profession—an altruism often tested and never in vain—than that shown by Drs. Richard P. Strong, Thomas W. Jackson, and many other doctors and trained nurses, and now finally by the chief of our corps—the friend of humanity—Major General William C. Gorgas in hastening, regardless of danger, to the relief of Serbia, sorely smitten by the deadly typhus fever?

Chenu's report gives a summary of the English as well as the French losses. Comparing it with Simpson's civil statistics eleven years later the mortality of the four selected amputations (arm, forearm, thigh and leg) was as follows: Of 2,089 of these four amputations in civil hospitals the mortality in Simpson's table was 41 per cent. In the Crimean War among the British there were 460 such amputations and 183 deaths, or 40 per cent. In the French army there were 5,972 such amputations with 4,023 deaths, a mortality of 67.4 per cent. In both armies disarticulation at the hip-joint had a mortality of 100 per cent., *i. e.*, every case died. It is instructive also to compare the fate of those who had an amputation of the thigh (1,666 French cases) with a mortality of 92 per cent., and 487 cases treated conservatively, *i. e.*, without amputation, with a mortality of only 70 per cent.!

In our Civil War Duncan quotes the figures of Fox, which are "the latest revised

statistics and are all larger than those of the Medical and Surgical History of the War." The average strength of the Union Armies was 806,755, and the deaths 359,528, of whom 67,058 were killed in battle and 43,012 died of wounds. This gives a battle death rate of 33 per 1,000 per annum. The disease death rate was 65 per 1,000 per annum. The case death rate from disease was only 3.4 per cent., a very low figure.

I can testify to the excellent condition of the Civil War hospitals, of which I saw many, but only in the East. When I say "excellent condition" it must be with the reserve that we knew nothing as to bacteriology, which did not exist, nor of infection, which was utterly unknown as to its causes and prevention. The general sanitary conditions, and by this I mean shelter, ventilation, cleanliness, good food, as good nursing as intelligent orderlies could give, etc., were all excellent. But the surgical conditions as we *now* know were simply dreadful. Practically every wound suppurated, and in summer I have seen many wounds swarming with squirming maggots as large as chestnut worms—disgusting, but, fortunately, not especially dangerous.

In my "Surgical Reminiscences of the Civil War"[17] I have given many statistics taken from the official Medical and Surgical History of the War, a few of which I will reproduce that you may see what blessed conditions you "free born" men have inherited. Pyemia (blood-poisoning) was one of our worst scourges. There were 2,818 cases, and of these only 71 recovered, a death rate of 97.4 per cent. Few of you probably have seen even one such case. I have given a matter-of-fact description of it in my "Surgical Reminiscences," but if you wish to see it sketched by a master's hand read that most touching and beautiful of all medical stories I know—"Rab and his Friends," by dear old Dr. John Brown, of Edinburgh. He vividly paints the sudden change in the wound, the pulse, the eye, the mind, on and on, worse and worse, until "that *animula, blandula, vagula, hospes comesque* was about to flee."

Tetanus had a mortality of 89.3 per cent. Of amputations at the hip-joint 83.3 per cent. died. Trephining had a mortality of 61 per cent. Even of ligations of the femoral artery, 374 in number, 281 died, or over 75 per cent. Of 2,235 cases of secondary hemorrhage, 61.7 per cent. died. Hospital gangrene, of which there were several hundred cases, had only a mortality of about 25 per cent., because we early learned the correct though empirical treatment, viz., the application of the actual cautery, pure bromine, strong nitric acid or similar destructive agents which killed the germ, whatever it was, and arrested the disease.

The Franco-Prussian War of 1870–71 was marked by notable progress in military sanitation in the German army, yet in spite of this there were 74,205 cases of typhoid fever, almost 10 per cent. of the entire average strength (788,213) and 8,904 deaths, a mortality of 11.3 per cent.

Surgically the results were nothing to boast of. Listerism had as yet made but little progress in the profession. Carbolic acid was used to some extent, but there was no thorough antiseptic system, for the germ theory was as yet neither understood nor accepted.

Of tetanus there were 294 cases, and 268 died, a mortality of 91.1 per cent.

The total of the four selected amputations was 2,194 with 1,196 deaths, a mortality of 54.5 per cent.—over one half.

Disarticulation at joints showed an average mortality of 56 per cent. Fifteen

[17] Keen, "Addresses and Other Papers," 1905, p. 420.

amputations at the hip-joint gave a mortality of 100 per cent., and resections claimed 40.2 per cent. of deaths. Even at the knee-joint Stromeyer amputated 36 times with 36 deaths and Nussbaum 34 times with 34 deaths.[18]

The French results were naturally worse, for their armies were constantly being defeated and retreating, and, especially in the latter part of the war, they consisted largely of volunteers, while the Germans were mostly veterans of the Schleswig-Holstein and Austro-Prussian wars.

Of the Boer War (1899–1901) only two features need be noticed. First, that typhoid attacked 57,684 men and killed 8,022, while the Boers only killed 7,781. Bacteria were more deadly than bullets, as Osler has said.

Secondly, the modern missile was for the first time in general use, with the result that instead of about 15 per cent. of the wounded losing their lives, only about 8.8 per cent. died. The wounds from the new missile were much less severe and healed more quickly than ever before. The first aid packet also had come to the aid of the soldier.

The Spanish American War, surgically speaking, was of little moment, as the numbers killed and wounded were too small to make the statistics of any great value, but it is gratifying to find that only 4.6 per cent. of the wounded died.

Typhoid, however, held high carnival. It caused 86.24 per cent. of all the deaths! Happily we can say that hereafter—thanks chiefly to the anti-typhoid inoculations—there will never be another such holocaust. (*Vide* Lecture II.)

The statistics of the Russo-Japanese War also need detain us for only a moment. I shall only quote the Japanese official statistics, as given by Major Lynch, of our army.[19] There were 47,387 killed. Of 173,425 wounded 11,500 died, a mortality of 6.7 per cent. The killed and those who died of wounds numbered in all 58,887, while the deaths from disease numbered only 27,158, a remarkable showing.

The present war naturally has yielded so far very few statistics. These can only be collected and tabulated after some years of peace. So far as I can judge, I fear that, while the mortality from disease (except perhaps from typhus, especially in Serbia) will be less than in former wars, the military conditions are such that the larger number of artillery wounds, the unavoidable delay in gathering the wounded into hospitals, the apparent absence of any truce for collecting the wounded and burying the dead, and the virulent infection from the soil may result in a large mortality rate and possibly a larger percentage than in previous wars in spite of the benefits of Listerism. But were the first-aid packet and the Listerian treatment not available the mortality ratio in this present horrible war unquestionably would be far greater than that which will be recorded.

This short résumé gives us some idea of surgical conditions preceding the great revolution inaugurated by Lister to which we will next proceed.

W. W. KEEN

[18] Wrench's "Lister," p. 236.

[19] "Reports of Military Observers attached to the Armies in Manchuria during the Russo-Japanese War," Part IV., p. 399.

LADY HUGGINS

LADY MARGARET LINDSAY HUGGINS, who passed into the higher life March 24, was a personality worthy to be classed with the group of pioneer women of the last century who, under difficulties, achieved distinction in intellectual fields.

Mary Somerville was deprived of her candle when her mother found that she was secretly studying Euclid; Anna Swanwick was denied

by her father any teaching in Greek as out of all propriety for girls; Agnes Clerke when a young girl could get no one to tell her about the stars, neither could Margaret Lindsay Murray, but they all struggled against odds and reached the goal of knowledge. Lady Huggins in a letter speaking of the death of Miss Swanwick, the distinguished translator of the tragedies of Æschylus, remarked:

> It is curious to me to notice what seems an inferiority in some very important ways among the young women coming on, who have had every possible educational advantage, when I compare them with such women as Anna Swanwick, who had to struggle for her education. I think perhaps everything at present tends to be made too easy. The present generation have more knowledge, I know, and they ought to do more; will they?

Lady Huggins said she was born a lover of the stars. Before she reached her teens she worked with a little telescope making drawings of the constellations and sunspots. Later, inspired by anonymous articles in the magazine, *Good Words,* she became interested in the spectrum, and made a little spectroscope for herself by which she detected the Faunhofer lines. It was the romance of her life that she afterwards became the wife of the astronomer who wrote the papers, and with him made many discoveries with the magic instrument. The London *Times* in its notice of Lady Huggins remarks that Richard Proctor called Huggins the "Herschel of the Spectroscope" and that his wife was to him what Caroline Herschel had been to her brother, an unwearied coworker.

She took upon herself to guide the telescope for the long-exposure photographs of the spectra of stars, she developed the plates with great skill, and her husband remarked on the keenness of her eye and judgment in arranging the plates in sequences representing stellar development.

The quest for knowledge of this pair was unremitting. Their absence from a notable scientific gathering in London was once noted, when she remarked:

> Astronomy is a heartbreaking science in England. We rarely go anywhere in the evening but wait for breaks in the clouds. We discover something which seems to be a clue to further knowledge and wish to pursue it; night after night the clouds disappoint us and sometimes we have to wait a year to take up that clue again.

Lady Huggins constantly shared the excitement of her husband in the early days of astrophysics when, as he said, "every observation revealed a new fact and almost every night's work was red-lettered by some discovery." She once remarked to a visitor passing in her laboratory a tray in which a fresh print was being washed:

> There is a bomb to be thrown into the astronomers' camp. It will be harmless, but effective.

Her name appears as joint author of ten of the scientific papers of the second volume of Tulse Hill Publications, and as joint editor of all. Of the epoch-making first volume, "The Atlas of Representative Stellar Spectra," she is joint author. These two and a third volume, entitled "The Royal Society," containing the addresses delivered by Sir William as president, are superb specimens of book-making, perfect in type work, illustration and binding, and this achieved by the taste and skill of Lady Huggins.

The great delight of her vacations was to unearth strange old astronomical drawings and reproduce them in India ink for the initial letters of the chapters of her books, or to make sketches in water-colors or by etching. An appreciation in an English paper remarks:

> Lady Huggins's striking and attractive personality expressed itself in her appearance and manner. There was in her not only the conscientiousness, thoroughness and care which should be the characteristic of the scientist, but also the imagination and love of beauty which distinguish the artistic temperament.

She published a paper on an astrolabe of rare workmanship, which appealed to her not only for its astronomical association, but for its "charm," as she expressed it.

Lady Huggins was greatly interested in the educational and scientific developments in the New World and especially in the "educational justice" now given women there. Entirely on her own initiative she presented to Wellesley

College Observatory some of her personal astronomical treasures, including stained glass panels once in the Tulse Hill home. Further bequests to Wellesley College are found in her will. In a letter written in her extreme illness, stating her decision to make this gift, occurs a passage which shows her vision of what America and the students of the American colleges ought to be and do.

The first sentence refers to the superb carrying out of the fire drill, which saved so many lives in the great fire of a year ago at Wellesley, and the energy and devotion of the alumnæ which raised the three million restoration and endowment fund. She says:

> I rejoice over the splendid spirit shown by the old Wellesleyans! I believe in the real great America! I believe in Wellesley College, one of its far-seeing creations! It is to such colleges for the training of young life to create the New Heaven and New Earth to which we all look forward.

SARAH F. WHITING

WHITIN OBSERVATORY,
WELLESLEY COLLEGE

THE UNIVERSITY OF MINNESOTA AND THE MAYO FOUNDATION

THE executive committee of the board of regents of the University of Minnesota has prepared a report in which it recommends that the university establish graduate work at Rochester, Minnesota, that such work be directed by the graduate school through its dean and the medical school graduate committee, that professors and other teachers be appointed on the nomination of the same committee, to carry on graduate teaching and research at Rochester, and that the offer of clinical and other facilities and gifts made by the Mayo Foundation be accepted.

The terms of the agreement are to be as follows:

1. The agreement is made between William J. Mayo and Charles H. Mayo as founders; the Mayo Foundation; Burt W. Eaton, George W. Granger and Harry J. Harwick, trustees of the $1,500,000; and the university. It sets forth copies of the articles of the foundation and of the two trust agreements and asserts or provides:

2. That the Mayos and their associates have entered into an agreement with the foundation for the period of six years after September 1, 1915, to pay all moneys and provide all subjects, facilities and material necessary to enable the foundation to carry out its agreement with the university.

3. That the board of regents is by law required to manage the university and appoint its professors and employees and fix their salaries and may accept in trust gifts and bequests upon the terms and conditions on which they are granted.

4. That the university is maintaining a medical school and is carrying on graduate medical and surgical instruction and has determined to increase its faculty, secure additional facilities, sites and material, appoint additional professors and assistants and carry on part of the work of the school of medicine at Rochester.

5. That the foundation gives and grants to the university free of charge the right to use for medical and surgical education and research space and rooms and equipment in a certain building in Rochester, together with all clinical and other materials and opportunities for graduate medical and surgical work available at the Mayo Clinic, St. Mary's Hospital, the Kahler Sanatorium and the Colonial Sanatorium in Rochester, for a period of six years after September 1, 1915.

6. That the foundation also agrees during that period to pay all salaries fixed by the board of regents and payable to professors, assistant professors and instructors appointed by the board.

7. That until September 1, 1921, the net income of each of the trust funds shall remain in the hands of the trustees as an added increment to the principal of the funds.

8. That from and after September 1, 1921, the principal of the funds and all accumulations to that date shall be turned over to and become the property of the university.

9. That the funds and the income therefrom are granted in trust to be used by the university as follows: (*a*) The principal shall always be kept intact by the board of regents and be

invested in suitable securities; (*b*) The income from the funds shall be used for the purpose of graduate medical and surgical instruction and research carried on under the direction of the board of regents at Rochester, Minn., with the understanding that appropriations may be made for carrying on medical investigations anywhere within or outside the state of Minnesota.

10. That the agreement may be terminated at any time on or before September 1, 1921, upon one year's notice given by either of the parties to the other, subject to the cooperation of all parties to discharge to the satisfaction of the university outstanding obligations to graduate students.

11. That the university accepts the gifts and grants, and obligates itself annually to furnish to the foundation until September 1, 1921, a budget stating the needs of this branch of the work at Rochester.

CONDITIONS AT THE UNIVERSITY OF UTAH

The committee of inquiry of the American Association of University Professors, appointed to report upon conditions at the University of Utah which have led to the resignation of seventeen members of the university faculty, has made a preliminary report. Its findings are concurred in by all the members of the committee who have been able to examine the evidence, who are: E. R. A. Seligman, chairman, Columbia University; John Dewey, Columbia University; Frank Fetter, Princeton University; J. P. Lichtenberger, University of Pennsylvania; A. O. Lovejoy, Johns Hopkins University; H. C. Warren, Princeton University.

The report is printed in full in *The Nation* and in *School and Society*. Of the eight findings of the committee three are as follows:

I. With regard to the nature of the grounds given by the president as his reasons for recommending the dismissal of certain professors on March 17 last, the committee finds as follows: (1) Of the four charges brought against these professors, two specify acts—namely (*a*) uttering in a private conversation with a colleague an unfavorable opinion of the chairman of the board of regents, and (*b*) speaking, in private conversation, in "a very uncomplimentary way of the university administration"—which are not proper grounds for the dismissal of university teachers. (2) The president of the university and the chairman of the board of regents, by sanctioning the recent action and publication of the board, virtually gave notice that the expression by a professor, in private conversation, of an unfavorable judgment of their qualifications for office would be a ground for dismissal. This attitude, unjustifiable in general, the committee regards as especially unsuitable in officials of a state university.

IV. One of the causes of the resignation of members of the university faculty was the existence of conditions before March 17, such that the faculty had no proper means of bringing its views on university matters—when its views differed from those of the president—to the notice of the governing body. It was, in the opinion of the resigning professors, partly in consequence of these conditions that the board, on March 17, took action which those professors regarded as unjust to individuals and injurious to the interests of the university. Since the resignations, the board has adopted radical and excellently conceived alterations in the plan of administration of the university; these changes should give the University of Utah an exceptionally advanced position among American colleges, in respect to provision for consultation between faculty and trustees. The committee hopes that great good will result from these modifications of the university's administrative machinery; it feels constrained, however, to reserve final judgment as to the actual effect of the plans until their working under local conditions has been tested by experience. The committee deeply regrets that the board has refused to apply its new procedure at once to the cases which have recently come before it. The committee deems itself bound, in simple justice, to note that the credit for whatever benefits may accrue to the university from the reforms mentioned, must be given primarily to the professors who by their resignations made effective protest against the antecedent conditions certain of which these reforms are designed to correct.

VIII. One of the gravest and most regrettable features of the crisis at this university, in the committee's opinion, is the attitude still maintained by the board of regents towards numerous petitions asking for a thorough public investigation of the recent incidents and of general university conditions. These petitions, which have come

from the faculty, the alumni association, the students, and a large number of citizens of the state of Utah, the board has in all cases rejected, declaring that it alone is responsible for the management of the university, that it has no doubts as to the correctness of its past action and the rectitude of its own motives and those of the president, and that it therefore can not permit its action to be influenced by protests coming from others. This position seems to the committee to show that the board fails to understand, or at least to act upon, three fundamental facts: namely, that every institution of public education, and especially a state university, requires for its success the confidence and respect of the public; that there can be no sure hold upon public confidence without an unflinching readiness to face publicity in regard to all official acts and policies; and that the only effective way in which any public body can meet serious charges brought by responsible persons is by not merely permitting, but demanding a searching and open inquiry into its methods. The committee gathers that the attitude taken by the board has aroused on the part of a large section of the local public, including a majority of the alumni and of the students, a degree of suspicion, and even hostility, which must be a continuing detriment to the university's efficiency as an instrument of public education, and must affect disadvantageously the position and the work of teachers in the institution.

THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION

AT a recent meeting of the Pacific Coast Committee of the American Association for the Advancement of Science, the first executive committee of the Pacific Division was elected in accordance with the provisions of the constitution of the division. The officers of the division have been elected by the executive committee. The result of these elections is as follows:

President: Dr. W. W. Campbell, Lick Observatory, Mt. Hamilton.

Vice-president: Dr. D. T. MacDougal, Carnegie Desert Laboratory, Tucson.

Secretary-Treasurer: Albert L. Barrows, University of California.

Executive Committee: Theodore C. Frye, University of Washington; Edward C. Franklin, Stanford University; C. E. Grunsky, San Francisco; George E. Hale, Mt. Wilson Solar Observatory, Pasadena; Vernon L. Kellogg, Stanford University; Andrew C. Lawson, University of California; E. Percival Lewis, University of California.

The Pacific Division is now supported by about one thousand of the members of the American Association resident within the region and by affiliations with twelve local scientific societies. After the San Francisco meeting of the American Association during the first week of next August, the recently elected officers of the division will carry on the work of the association on the Pacific coast which up to this time has been conducted by the Pacific Coast Committee. The first meeting of the Pacific Division will be held in the spring of 1916.

SCIENTIFIC NOTES AND NEWS

COLUMBIA UNIVERSITY has conferred its doctorate of science on Robert S. Griffin, rear-admiral and engineer-in-chief, U. S. Navy, and Arthur L. Day, director of the geophysical laboratory, Carnegie Institution of Washington.

THE Stevens Institute of Technology has conferred the degree of doctor of science on Otto H. Tittmann, for many years superintendent of the United States Coast and Geodetic Survey.

DR. V. G. HEISER has resigned as director of health in the Philippines, to accept the position of director for the Orient of the work of the Rockefeller Foundation.

DR. RICHARD H. CREEL, of the Federal Health Bureau, has declined the offer of the post of health commissioner of Boston.

DR. ELWOOD MEAD, who has accepted a call to the newly established professorship of rural institutions in the University of California, has been appointed by Secretary Lane chairman of a central board of review of the committees on revision of reclamation project costs.

A TESTIMONIAL dinner was tendered to Dr. Leo Loeb at the University Club, St. Louis, on May 25, by members of the medical profession of St. Louis, the scientific faculties

of Washington University and St. Louis University and members of the Biological Society of St. Louis.

A testimonial dinner to Henry Smith Munroe, professor of mining in Columbia University, 1877–1915, was given by his old students in the schools of mines, engineering and chemistry at the Chemists' Club, New York, on May 28. The special occasion for this was the approaching retirement of Professor Munroe at the close of the present collegiate year. Professor Munroe, who is the senior member of the faculty, will then have completed thirty-eight years of service. The speaking following the dinner was begun by R. V. Norris, president of the Alumni Association, who introduced Professor J. F. Kemp as toastmaster. The other speakers were President Nicholas Murray Butler for the university; Thomas Haight Leggett for the American Institute of Mining Engineers; Walter Renton Ingalls for the Mining and Metallurgical Society of America, and John Parke Channing for the alumni. In concluding his remarks, Mr. Channing presented to Professor Munroe, on behalf of his former students, a massive bronze—the Sluice-Miner—by Louis Potter. To these speeches Professor Munroe replied.

The Alpha Chapter of the Society of Sigma Xi has elected the following officers for 1915–1916: *President,* J. G. Needham; *Vice-president,* F. K. Richtmeyer; *Recording Secretary,* J. G. Pertsch; *Corresponding Secretary,* James McMahon; *Treasurer,* O. A. Johannsen.

At the annual meeting of the Yale Chapter of Sigma XI, Professor L. L. Woodruff was elected president and Dr. H. L. Seward vice-president. Professor R. S. Lull will give the address at the joint commencement meeting of Sigma Xi and Phi Beta Kappa at Yale.

Dr. James W. Jobling, of the Vanderbilt School of Medicine, Nashville, Tenn., was elected president of the American Association of Immunologists at its recent Washington meeting.

Professor Alfred Dachnowski, in charge of plant physiology and ecology at Ohio State University, has accepted a position in the bureau of plant industry, U. S. Department of Agriculture. He will continue his investigations upon peat soils and their agricultural utilization.

Mr. G. L. Fawcett, plant pathologist of the Porto Rico Experiment Station at Mayaguez, resigned in February and has gone to Argentina, where he has accepted a position as plant pathologist of the Experiment Station at Tucuman.

Mr. Louis G. Schultz, director of the Argentine Central Magnetic Observatory at Pilar, since its foundation in 1903, has recently resigned and returned to the United States.

Poul Lindholm, engineer of highways, Copenhagen, Denmark, has been awarded the traveling fellowship of the American Scandinavian Foundation for 1915–16. He will devote the year to graduate work in highway engineering at Columbia University.

Professor Hans Ludendorff has been appointed head observer in the Astrophysical Observatory at Potsdam.

Dr. R. Tait McKenzie, director of the department of physical education at the University of Pennsylvania, sailed on May 29, for London, where he will take charge of the new physical department established by the British government to care for the health of recruits.

Professor John M. Coulter, of the University of Chicago, will give two courses of lectures in the University of California during their summer session, which begins on June 21. One of them is an elementary course in evolution and heredity; the other is an advanced course in the evolution of sex in plants.

Professor Graham J. Mitchell, of the department of geology of the University of Oregon, will spend the coming summer in Curry County with Professor B. S. Butler, of the school of mines of the Oregon Agricultural College. Professor Warren D. Smith, head of the department of geology of the University of Oregon, will spend a part of

the summer studying the stratigraphy of the western slope of the Cascades. Both of these pieces of work will be carried on for the Oregon Bureau of Mines and Geology. During three weeks of the summer between July 12 and August 1, Professor Smith in cooperation with Professor Sweetser, of the botany department, University of Oregon, will conduct a field class to Crater Lake.

PROFESSOR JOHN H. SCHAFFNER, of the Ohio State University, will spend two months this summer in Kansas, Arizona and California, making a detailed study of the conifers of North America.

DR. W. RALPH JONES, scientific assistant in plant pathology in the office of Fruit Disease Investigations, of the U. S. Department of Agriculture, died on May 17, in the thirty-second year of his age. Dr. Jones was a graduate of Johns Hopkins University and had been engaged in the study of small-fruit diseases for several years.

DR. SAMUEL BALDWIN WARD, since 1884 dean of the Albany Medical College and professor of the theory and practise of medicine, died on June 3 at the age of seventy-three years. He was graduated from Columbia University in 1861 and from the medical department of Georgetown University in 1864. From 1867 to 1869 Dr. Ward was curator of the medical museum of Columbia University. He was professor of anatomy at the Woman's Medical College of the New York Infirmary from 1867 to 1870, and of surgery from 1870 to 1876. From 1876 to 1884 he was professor of surgical pathology at the Albany Medical College.

MANY American men of science, especially the geologists who participated in the Gaspé excursion of the Twelfth International Geological Congress, 1913, will learn with regret of the recent death at Gaspé, of Commander William Wakeham, Dominion inspector of marine fisheries in the Lower River and Gulf of St. Lawrence. Commander Wakeham was the courteous and delightful host on this occasion, of the geological party on board his cruiser *Princess* in a trip down Gaspé Bay. Dr. Wakeham's entire professional life was spent on that coast, first as physician, then as magistrate and inspector of fisheries for the Quebec coast, and subsequently as His Majesty's commissioner for the preservation of the fisheries in Canadian Atlantic waters. He attained distinction for his intimate knowledge of fish, fish breeding and fisheries procedures and was recognized as a leading authority in these fields, while his long life and intimate concern with all the activities of the coast made him the most influential and most widely informed personality of the Gaspé country.

AMONG the passengers on the *Lusitania* was James Blaine Miller, of the Coast and Geodetic Survey. No information in regard to him has been received and there is practically no doubt that he went down with the vessel. James Blaine Miller was born in Erie County, Pennsylvania, October 30, 1883. He graduated from Oberlin College, Ohio, in June, 1903, with the degree of bachelor of arts. He was appointed an aid in the survey June 18, 1903, was promoted to assistant September 1, 1906, and during his twelve years of service was employed chiefly on hydrographic and leveling work in various localities. In 1904 he was engaged in surveys in Porto Rico. In 1906 he was in command of the steamer *Endeavor* in the survey of Chesapeake Bay; in 1906 he was placed in command of the steamer *Research* in the Philippine Islands; in 1909 he was transferred to the command of the *Fathomer;* in 1911 he returned to the United States and in the fall of that year he was placed in command of the steamer *Patterson* for surveying work in the Hawaiian Islands and on the coast of Alaska. He was detached from the command of the *Patterson* in March of the present year, and had been granted leave for several months to take a trip abroad.

SCIENCE of June 4 mentions the death in the European war of Joseph Déchelette and Captain M. Bourlon, both of whom have made valuable contributions to French archeology. The last number of *L'Anthropologie* adds to these Captain René Avelot, known for his contributions to geography and especially those dealing with the ancient populations of cen-

tral and eastern Africa; and Captain Maurice Cortier, an eminent topographer, active in archeology in the territory of Sahara.

Sir Arthur Herbert Church, formerly professor of chemistry at the Royal Academy of Arts, London, known for his contributions to chemistry and mineralogy, has died at the age of eighty-one years.

Dr. Ernst Meumann, professor of psychology at Hamburg, known for his contributions to experimental and educational psychology, has died at the age of fifty-three years.

The death is also announced of Dr. Stefan Witasek, director of the psychological laboratory at Gratz, at the age of forty-five years.

Dr. Oskar Simony, emeritus professor of mathematics and physics in the Agricultural School at Vienna, has died at the age of sixty-three years.

The Brooklyn Botanic Garden was opened on June 5 for inspection by its members and invited friends and, on the following day, it was opened to the general public, and will remain open, free to all, daily hereafter.

The third annual meeting of the American Association of Anesthetists will be held in the New Auditorium, San Francisco, on June 21, under the presidency of Dr. Charles K. Teter, of Cleveland. There will be two scientific sessions, the first item on the program being the address of the president, who will speak on the subject "Nitrous Oxide Oxygen Anesthesia in Obstetrics."

There has been founded by the graduate and undergradute students of the department of geology and mining of the University of Kansas a professional fraternity, Sigma Gamma Epsilon. It is proposed to establish chapters of the organization in the leading educational institutions of the United States and Canada. At present there does not appear to be any such fraternity and it is hoped that its organization will promote an increased interest in geological science.

At the election of members to the Society of the Sigma Xi held recently by the Omega Chapter of the Ohio State University the following candidates were chosen: Professor J. Warren Smith, professor of meteorology from the faculty; seventeen young men and two young women from the graduate school and fourteen young men from the fourth year or senior class. This is the largest number ever elected by the Omega chapter. The greater increase is from the graduate school, as candidates from this class are not eligible unless they have done creditable research work as well as shown an inclination and ability to continue such work.

The newly established chapter of Sigma Xi was installed at the University of Texas on the evening of May 17. The installation exercises were conducted by Professor S. W. Williston of the University of Chicago. Professor Williston gave an interesting public lecture on "The Contribution of Texas to our Knowledge of Early Land Life." Following the lecture the installation proper took place at the university club house in the presence of the charter members, initiates and invited guests. The chapter consists of twenty-one charter members and eleven newly elected members. The following are charter members: C. L. Baker, E. C. H. Bantel, S. L. Brown, J. M. Bryant, H. P. Bybee, D. B. Casteel, E. L. Dodd, W. S. Hunter, D. J. Jones, T. L. Kelley, J. M. Kuehne, I. M. Lewis, F. McAllister, J. T. Patterson, M. B. Porter, A. Richards, E. P. Schoch, F. W. Simonds, F. L. Whitney, C. S. Yoakum and M. S. Young. The newly elected members are: F. D. Barrow, Mrs. L. T. Binkley, A. Deussen, W. A. Felsing, C. G. Hartman, Miss Goldie Horton, W. T. Read, E. W. Schuhmann, B. C. Tharp, T. U. Taylor and J. A. Udden. The following officers have been elected for the coming year: :

President: Professor J. T. Patterson.
Vice-president: Professor F. W. Simonds.
Recording Secretary: Professor E. L. Dodd.
Corresponding Secretary: Professor I. M. Lewis.
Treasurer: Professor S. L. Brown.

Mt. Lassen, California, whose violent eruption of May 19 places it in the first rank of volcanoes now dangerously active, has become the subject of an informal cooperative study by the geological survey and the forest service. At the request of the survey, a tele-

gram has been sent from Washington instructing the officers of the Lassen national forest, in which the peak stands, to continue observations of the volcano's activity and keep a record to be used as a basis for a scientific investigation by J. S. Diller, the government geologist, who is expected at Lassen early in July. The observations are being made by forest rangers at the scene and from a fire lookout tower on Brokeoff Mountain, a few miles north of the crater, where the forest service last year kept watch on the numerous eruptions which occurred from May to September. It is not known whether a cloudburst started the last eruption by precipitating rain down upon the molten lava in the crater, or whether melting of the snow on the peak, with consequent flowing of water into the crater, caused the accumulation of steam which blew a river of mud out of the mountain. Mr. Diller, who made a study of the volcano last year, said that he inclined toward the melted snow theory, adding that the bright glow reported as appearing on the clouds of smoke and steam over the crater is a reflection of the red-hot matter uncovered by the eruption, indicating that the volcano is in a more or less dangerous mood. The river of mud which was shot out of the north side of the crater and down Hat Creek has damaged government and private property, destroying bridges which were necessary to permit the entrance of livestock that are grazed on the forest range during the summer. Some 12,000 cattle and 30,000 sheep are grazed on the Lassen forest every year.

SPECIAL arrangements have been made for the members of the Geological Society of America and of the Association of American Geographers attending their summer meetings and the sessions of the American Association for the Advancement of Science at San Francisco beginning August 2, 1915, for a "special" over the Santa Fe Railroad leaving Chicago on July 23 at 10:30 P.M. and Kansas City at 11 A.M. on July 24. Numerous stops and short side-trips are provided for to visit points of particular geological interest and especially places best showing the features of desert erosion, the latter subject being one of the main themes of discussion at the sessions. For a limited number of other members of the American Association for the Advancement of Science who are intending to be present at the San Francisco meetings and who wish to join the special party, ample provision will be made. Those joining the special party may return home individually at any time and over any route. The cheapest way will be for each person to purchase a round-trip railroad ticket at his home town, via the Santa Fe route from Chicago and Kansas City to San Francisco, with returning privileges over any other route he wishes; this includes stop-overs at Los Angeles and San Diego without additional cost. Pullman reservations, Chicago or Kansas City to San Francisco, should be made early by direct communication with Mr. Samuel Larimer, general agent, passenger department, Sante Fe Lines, 315 7th St., Des Moines, Iowa. The geological direction of the special party will be under the supervision of Dr. Charles Keyes, Des Moines, Iowa, to whom communications may be addressed concerning full information and detailed itinerary. The cost of the side-trips, etc., for the five extra days on the way going will be about $25.00 above regular individual fares, or about $35.00 if the Painted Desert trip is taken.

THE third annual joint field meet of the United States Bureau of Mines, the American Mine Safety Association and the California Metal Producers' Association will be held at the Panama-Pacific Exposition on September 23 and 24. It is expected that there will be a large attendance of mining men, as the joint meet will either precede or follow the annual meetings of a number of institutions allied to the mining interests, such as the American Institute of Mining Engineers, September 17 and 18; the International Engineering Congress, September 20 to 25; the American Mining Congress, September 20 to 22; the California State Mine Rescue and First Aid Contest, September 22; and the National Safety Conference, under the joint auspices of the National Safety Council and the California Industrial Acci-

dents Commission, September 27 to 30. On September 23, on the athletic field of the Panama-Pacific International Exposition, there will be a mine-rescue demonstration at 10 o'clock; at 2 o'clock in the afternoon there will be a first-aid demonstration; and at 4 o'clock a demonstration of the explosibility of coal dust. On September 24, at 10 o'clock, will be held a first-aid contest for inter-state supremacy; at 2 in the afternoon a rescue contest for inter-state supremacy; at 4 in the afternoon a rock drilling contest, and at 8 o'clock in the evening, there will be an award of prizes and souvenirs at the convention hall.

UNIVERSITY AND EDUCATIONAL NEWS

The Illinois legislature has passed a bill appropriating $5,000,000 for the use of the University of Illinois for the biennium beginning July 1, 1915. This amount lacks but little of being the whole of the fund that has accumulated in the state treasury from the one-mill tax voted four years ago for the support of the state university.

By the will of Miss Helen Collamore, of Boston, $100,000 is bequeathed to Simmons College, $20,000 to Radcliffe College and $10,000 primarily to aid women students in post-graduate courses in the Massachusetts Institute of Technology.

The General Education Board plans to enter the field of educational research by assisting workers of institutions of learning, as well as supporting experiments and inquiries. Further progress is reported in the project for establishing an institute for training public health workers. A model county organization will be perfected in Mississippi, with the cooperation of the state superintendent. Several appropriations are also announced. Two hundred thousand dollars are subscribed to the Vassar College endowment fund, $125,000 to that of Denison University, Granville, Ohio, and $100,000 to Pomona College, Claremont, Cal. The sum of $140,650 is appropriated for the current year's work in developing secondary and rural schools for both white and Negro races. The board has contributed $21,000 for continuing the farm demonstration work for children's clubs in Maine and $10,000 in New Hampshire, undertaken with the agricultural colleges of these states.

Professor R. J. Pool has been chosen by the board of regents of the University of Nebraska to be acting head of the department of botany, to fill the place made vacant by the death of Professor Charles E. Bessey. J. E. Weaver, for two and one half years connected with the botanical department of Washington State College, and for the past year with the botanical department of the University of Minnesota, has been appointed assistant professor of botany in the department.

Dr. Joseph Peterson, the circumstances of whose resignation from the chair of psychology in the University of Utah have been noted in this journal, has been appointed professorial lecturer in the University of Minnesota. Other appointments at Minnesota are: Elmer J. Lund, assistant professor of zoology; Robert C. Ashby, assistant professor of animal husbandry; Jean MacKinnon, assistant professor of nutrition; Lucile Wheeler, assistant professor of foods and cookery; Merritt R. Grose, instructor in chemistry, and John C. West, instructor in physical education.

Dr. George W. Corner, now on the staff for gynecology of Johns Hopkins University, has been appointed assistant professor of anatomy, and I. C. Hall, formerly of the Cutter laboratories, assistant professor of bacteriology, in the University of California.

At the University of Illinois Robert Stewart, professor of chemistry in the Utah Agricultural College has been appointed associate professor of soil fertility and assistant chief in soil fertility in the Agricultural Experiment Station. Gilbert Gussler, of the University of Ohio, has been appointed associate in animal husbandry in the College of Agriculture. R. D. Carmichael, of the University of Indiana, has been appointed to be assistant professor of mathematics in the university.

Lee R. Dice, Ph.D. (California, '15), has been appointed instructor in zoology at the Kansas State Agricultural College.

PROFESSOR GILBERT GUSLER, of the Ohio State University, has been appointed to a position as associate in the department of animal husbandry of the University of Illinois.

DISCUSSION AND CORRESPONDENCE

COMPLEXITY OF THE ALEXANDRIAN SERIES

UNDER the tacit encouragement of our federal and state geological bureaus the unfortunate practise of continually displacing already well-defined and useful terranal titles by new ones, often of very doubtful utility, with the idea in mind that such continual change in nomenclature is the only essential element in the advancement of knowledge, seems to be notably increasing rather than showing any appreciable signs of wane. Lest the shadow permanently be mistaken for the substance every contemplated case of renaming demands beforehand the closest scrutiny.

It was a similar tendency, a generation ago, that led the various geological surveys to dispense with the services of the paleontologist and to adopt the lithologic unit in stratigraphic classification and in cartographic representation. In new form the remaining mania still refuses to be downed.

A recent concrete case is the proposal of the name Alexandrian for an Early Siluric series in the Mississippi Valley. This instance is no worse than a multitude of others. It is selected at random, chiefly because it illustrates in small compass more points than any other that comes to mind. Moreover, it emphasizes three facts of universal application.

There is first the doubtful expedient of erecting groups so large as that of series by merely throwing together all strata lying between two well-known horizons. Second, there is the pernicious habit of making inconsequential additions to or subtractions from already defined formations and proposing therefor entirely new names, when the old terms easily answer without violation of a single canon of nomenclature. In the third place there is little or no consideration of paleogeographical conditions. Until the last-named factor is recognized in something of its true perspective there can be little real progress in the solution of the broader problems of local statigraphy.

Now the Siluric section of northeastern Missouri is quite remarkable because of the fact that it is so meagerly represented, because it is divided medially by a marked plane of unconformity, and because there is an overlapping of a southern earlier Siluric deposition by a northern later one.

In the proposal of the term Edgewood formation to include the Bowling Green limestone, the Noix oölite, a local phase of what was later called the normal Noix limestone as noted by Ulrich, and the lower normal limestone to which recently the name Gyrene limestone was given, the significance of the notable plane of unconformity at the base of the Bowling Green member was completely overlooked. It now transpires that the stratigraphic affinities of this formation are with the northern, or Iowa, section instead of with the southern or southern Missouri sequence; that its time relations are with the Mid Siluric rather than with the Early Siluric sub-period. In consequence of these facts Edgemont as a terranal designation becomes at once invalidated.

By slight change in the original signification of the term Noix, as applied to a limestone member, this name assumes a useful and valid rôle. The appellation Cyrene for a limestone becomes wholly unnecessary. If in the north Missouri region the term Alexandrian series is to be retained as a permanent stratigraphic title with a taxonomic rank of series it will have to be restricted in its application to the Siluric strata below the plane of unconformity marking the base of the Bowling Green limestone.

According to the rule of nomenclature laid down by its author the term Alexandrian would have to be abandoned and a new title proposed. There is urgent need of a serial term for the Early Siluric section of the Ozark region. It appears a happier treatment of the problem to retain a name already in use, modifying its delimiting application slightly to meet the exigencies of newly discovered relationships. Only in this way can the interests of stable geologic nomenclature be best sub-

served and a term like Alexandrian series be established as a valid stratigraphic title.

Charles Keyes

ALABAMA ARGILLACEA IN MINNESOTA

The cotton-worm moth, *Alabama argillacea* Hubn., appeared in Minnesota during the past season at several different places. The first recorded appearance was at Garden City, Blue Earth County, September 21, where it was proving injurious to a variety of everbearing strawberries. The moths punctured the fruit and apparently did considerable injury.

Between the tenth and the fifteenth of October, several other inquiries from other places were received, complaining of this moth injuring strawberries. One complaint came from Rochester, Minn., one from St. Paul, and one from Excelsior, which is on Lake Minnetonka, west of Minneapolis. The moths apparently stayed but a very short time in each of these places. Between the fifteenth and nineteenth of October the nurseryman at Garden City, Minn., had further trouble from these moths. He stated in a letter that they were most abundant about the twentieth of September, after which they disappeared, becoming rather scarce, but appearing again in numbers about the fifteenth of October.

These few notes may be of interest to entomologists, as they show the northern flight of the moths; also that they will feed on fruit, if fruit is available at that time.

William Moore

Division of Entomology,
University of Minnesota

CHEMIHYDROMETRY

The writer has been searching for a name for the new method of measuring the flow of rivers, the discharge of turbines and the capacities of reservoirs by means of chemicals mixed with liquids. *Chemihydrometry* seems to convey the idea exactly, but it can be criticized in at least two respects. It is a compound whose component parts are derived from two different languages, which is not good form, and the second part is almost exclusively used when it refers to the determination of density or specific gravity.

An appropriate name for this new branch of engineering will soon be in demand and it is, therefore, suggested that other names be submitted by your readers for consideration.

B. F. Groat

EYE SHADES FOR MICROSCOPICAL WORK

To the Editor of Science: The eye shade described in Science for May 28 is identical in plan though not quite as perfect in construction as one sold for many years by dealers in microscopic supplies. It was designed by Dr. R. H. Ward and is illustrated in earlier editions of Gage, "The Microscope" (*e. g.*, VI. ed., p. 59), and in various catalogues of micro accessories as Ward's Eye Shade. In the later editions of Professor Gage's book it is replaced by another form which in the author's judgment probably meets the needs of the case more satisfactorily.

The discussion which Professor Gage gives in connection with the figure of the eye shade regarding the care of the eyes is worthy the more careful consideration of the laboratory teacher. Such problems receive little, if any, attention in the training of graduate students, and college classes suffer when every new generation of teachers comes to practise on them.

X

SCIENTIFIC BOOKS

The Climatic Factor as illustrated in Arid North America. By Ellsworth Huntington, with contributions by Charles Schuchert, Andrew E. Douglass and Charles J. Fullmer. Carnegie Institution of Washington, Publ. 192, 1914. 4to. Pp. 341, richly illustrated.

The senior author of "The Climatic Factor" has for a number of years endeavored to throw light upon the relations between changes in climate and human activity, and the wealth of fact which he personally has hitherto brought to light and correlated with the investigations of others, especially archeologists, in that region called the cradle of western civilization, together with interpretation in terms of climatic oscillation, have won for him much recognition both from a wide circle of the

intellectual laity and within the narrower circle of more critical students. A more fascinating volume to those who endeavor to glimpse the ancients as living beings overcoming and being overcoming by their environments, than "Palestine and Its Transformation" has rarely been written, and in it Professor Huntington in a measure has anticipated the feature of the present volume which to the biologist especially will make the most intimate appeal. As the author remarks in his preface, his thesis of climatic pulsations within measurably recent times may till now have been open to the criticism that the facts may have been arranged to fit the theory, but granting this to be so, we have now given us indubitable evidence, mathematically treated, derived from growth rates of the "big trees," so that in the absence of instrumentation we are supplied with a rainfall curve dating back over 3,000 years, which, viewed broadly, is little less dependable for that lack.

The method of attaining this end is credited to Professor A. E. Douglass, who, while resident in Flagstaff, conceived the idea of showing association between meteorological variations and astronomical phenomena during long periods of time for which records are not available. This method is presented by him in Chapter XI. of the volume. The fundamental data are the measurements of the growth rings in old trees obtained in numbers sufficient to allow the determination of the amount of error due to various causes and their elimination. The errors considered by Douglass are those introduced by the irregularities of growth due to discontinuity of moisture supply during the growing season, such errors being of relatively greater importance in comparing growth and recorded rainfall, during a comparatively short period of years. The results of the investigation are correct within a range of 70 to 82 per cent., and certainly sufficiently so to warrant reliance upon tree growth as an indicator of climatic variations. Growth rates for a period of 500 years were then studied, a correction for age being indicated, and from the result it is clearly to be inferred that climatic pulsations have occurred during the period in question. These, it is finally argued, are expressions of weather changes due to sunspot activity, a view supported by data from German trees.

In the following chapters Huntington applies the above method, introducing an additional correction for "longevity," the effect of which is to still further rectify the curve embodying a correction for age, and to make the sinuosities of the growth curve comparable at all points throughout its extent. The evidence for pulsations of growth is further found in trees widely scattered from Maine to California. It is, however, to be noted that inverse growth fluctuations occur, as for example when a change which produces a "drought in the north may produce an excess of moisture in the south." This extension of method then leads the way to a dramatic climax in the following two chapters in which the special difficulties presented by the "big trees" of California are dealt with and the interpretation of their growth curves is presented. The original data are recorded in the statistical portion of the volume, where 28 pages are found crowded with tabulated figures at which one must look in order to form some conception of the enormous amount of work of a purely inductive kind upon which the author's conclusions rest. The derived curve of tree growth for 3,000 years and the curve for climatic change in western Asia based upon historical data, on page 172, must remain, whatever the minor inaccuracies may turn out to be, of preponderating interest for students of climate, and will become an item of classical value.

From these curves there emerges the conclusion that beyond the cycles of lesser amplitude embraced within shorter time periods (120, 21 and 11 years) others occur "of the length of centuries" but without recognizable periodicity, and that these pulsations, to use the author's favorite term, have been synchronous in western America and western and central Asia. His methods, tested against each other in this volume, point also to a condition 300 years ago on the whole moister than now obtains.

Inquiry into the possible causes of the discoverable fluctuations occupies Chapter XIX., in which a variety of evidence, including solar

constants, sun-spots, the prices of wheat, size of crops, growth of trees and comparative temperature fluctuations at various points of the earth's surface, contributes to support the conclusion that the "solar hypothesis," meaning the occurrence of sun-spots and a correspondingly cyclic change in the sun's radiation are sufficient to and do account for the causation of measurable meteorological results. The larger question of climatic change during the vast extent of geological time is attacked by Dr. Charles Schuchert in a paleometeorological monograph incorporated into the volume as Part II., in which the crustal deformation of the earth due to gravitational agencies is seen as the cause of change and redistribution of climatic zones. It seems conclusive that periods of mountain-making have been followed by cooler times, though, as Huntington and Schuchert both admit, there still remains the difficulty of accounting for the apparent causal relation between these, for the minor fluctuations of climate which are now in progress, and for the interglacial climates characterized by higher temperatures. At this point the solar hypothesis appears to articulate with that of crustal deformation. A full and impartial discussion of all the theories, in itself quite exemplary, strengthens the authors' positions, but for these details the original volume must be examined.

There remains of the reviewer's task a necessarily brief and equally inadequate mention of the body of evidence from the point of view chiefly of human activity, but including certain topographic facts.

The salient condition for the studies lies in the sensitiveness of the semi-arid desert to apparently minor deviations from the normal course of rainfall, and, for the author's purpose, its effect upon human economy. That these fluctuations of precipitation have occurred, there is abundant evidence in records, and in the fate of modern enterprises; and, according to Huntington, in the making of terraces, new and old, but all embraced within comparatively recent times, which can be seen at the present time well illustrated in the Santa Cruz River at Tucson, in the different levels of lake beds, in the fixation of older and movement of later sand dunes, as illustrated in the White Sands of the Otero basin and in the different ages of ancient aboriginal villages. Evidences of an earlier large population were studied in localities found in the whole wide region from south New Mexico to northern Sonora. The close examination of these evidences is so masterfully done, and with such intimacy of touch, that one feels, as it were, a thread of drama running through it. While the contemplation of history seems to lengthen the years agone, that of the earlier culture of the desert seems, in these studies, to bring us nearer to the past. In particular, the account of the condition on the lower Altar may be cited in illustration of method and treatment. This valley, beginning at the village of Altar and ending at Disemboque on the Gulf of California, contains a string of villages either occupied, as Caborca, with 1,500 inhabitants, and Buzani with a mere handful, but with the ruins of a mission, or uninhabited—and recognizable only from the usual signs—artefacts, foundations, canals, villages extensive enough to accommodate 1,500 folk, perhaps more. Lands now either cultivated opportunistically, but less and less as the gulf is approached or not at all, but always extensive enough for the support of large numbers of the primitive people, together with signs of irrigation works, combine with the ruins, to form a setting for a numerous people. But the people are not there. All the facts point to a condition when agriculture was possible and water was in quantities sufficient to supply the villages by means of canals, in the absence of wells (as at Buzani). A feature of especial interest described is the curious terraces or trincheras found at various localities. These merge with rectangular areas, discernible now only from an eminence, on the lower gentler slopes. These trincheras were undoubtedly for agricultural use, and this view taken by Huntington, receives support from the occurrence of similar trincheras observed by the reviewer in the fastnesses of the Sierra Madre of Chihuahua, associated with the ruins of ancient villages. But if for agriculture, whence the water? A little arithmetic shows pretty conclusively that they could not have been irri-

gated, since the work, which would have been done by the women, would have amounted in the case of the Great Trinchera to enough to demand a population of 15,000, "where now there are scarcely more than 200," in view of which it seems far more likely that dry farming was possible, and this in turn supposes a greater rainfall than occurs at present.

But the main effort is to show that not only has there been a change in rainfall during the last few hundred years, but that the whole region studied presents evidences of successive stages of culture. The evidence derived from human agencies is of course the more difficult to obtain and interpret, but taken together with that from other sources, it gives more than suggestive strength to the discussion. For example, the early Spaniards found no inhabitants in the Chaco Canyon, while their artefacts show them to have been different from the more modern Pajaritans. The extremely dry character of the region indicates that it would have become uninhabitable earlier than other localities which have been occupied at later dates.

In this connection southern Mexico is treated as a test case and similar conclusions are arrived at, while three other chapters deal with Yucatan, with Guatemala and the Highest Native American Civilization, and with the Relation of Climatic Changes to Mayan History. The rich indications, buried now in well-nigh impenetrable jungle, of a highly able and intelligent people, are found in a region which forbids at the present any approach to civilization at all, in view of the great heat, disease and the consequent debilitating effects. But a small decrease in rainfall would alter these conditions, so that what would cause the disappearance of people in temperate regions would permit their greater development in the tropics, since a diminution of rainfall sufficient to allow the development of dense forests would cause them to be replaced by jungle, and the jungle, in turn, by bush. A healthful atmosphere would thus displace a noxious one, and human progress, otherwise inhibited, would be stimulated. But this means that while the deserts of the southwest are drier now than formerly, the scenes of former Mayan greatness are now moister, in apparent contradiction to the major thesis of the volume. At this point a paper is contributed by Dr. Charles J. Kellmer on "The Shift of the Storm Track." It is shown that during an interval of 21 years the storm track has shifted a small distance to the west and south, and it is perhaps more than a mere coincidence that the magnetic pole has also shifted (according to Bauer) westward and (chiefly) southward. This broaches the subject of the latitudinal change of climate due to this cause, and if, as Huntington contends, such changes have occurred in the lands of the Mayas, the general contention that the profound changes in human culture, indicated by their reliquiæ, are due to them. In this light, the Mayan history is reviewed in Chapter XVIII., and a parallel is drawn between the climatic changes as registered by tree growth and the rise, decline, renascence and ultimate reduction to a rather low grade of culture, of the Mayan people, not so low, however, as that of other tropical peoples. In this study, history and archeology are brought together, and if the results are, as Huntington says, not too much to be depended on, the treatment again illustrates the method of coordinating evidence from these and other sources in order to get a broader view of the possible causes of culture changes in the past. The sum total of the work is to strongly indicate a general parallelism between these changes in central America and the desert regions to the north and those of central and southwestern Asia as correlated with the climatic pulsations indicated in the growth records drawn from a minute's study of the California trees.

The volume is a big one, and really too big and too detailed, and with evidence drawn from too many kinds of sources for competent review by a single reader. If this review fails in the critical attitude, a good purpose will be served if, besides indicating the scope of the studies, the general attention is directed to large and conscientious effort, supported by great if restrained enthusiasm, to work out an intricate problem which has an intimate bear-

ing on the history of the human race, that of the relation of culture to climate. Much as has been done, the author would be the last to say that more than a breaking of the ground has been accomplished. He himself is as busily engaged now as before, deriving evidence from all sources available to him, as witness the recent papers on the relation of climate and civilization, work and weather, in *Harper's Magazine,* forecast doubtless of more extensive study of the same kind.

A single matter of book-making should be especially mentioned. In a note to the reader, following the table of contents, a list of segregations of chapters is given for the direction of those more especially interested in one field of thought than another. Such schemes are helpful in these days of much publication.

Francis E. Lloyd

McGill University

THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (NUMBERS 1–4)

Four numbers of the *Proceedings of the National Academy of Sciences* have now been issued. These contained in 258 pages a total of 70 articles, including the report of the autumn meeting of the Academy. The average length of the contributions was therefore 3.7 pages, which lies well within the limit of 6 pages, or 2,500 words, set by the editors.

The number of articles in the various branches of science is as follows:

Mathematics	11	Astronomy	11
Chemistry	13	Geology	2
Paleontology	1	Botany	4
Zoology	5	Genetics	5
Bacteriology	2	Physiology	8
Anthropology	5	Psychology	2

The inadequate representation of certain sciences, such as physics, geology and pathology, is largely accidental, as many authors in these fields have indicated their intention of contributing to the *Proceedings.*

The arrangement of the articles according to geographical distribution into Eastern, Middle West, and Pacific also shows a reasonable distribution over the whole United States. The figures are:

Eastern	Middle west	Pacific
35	21	13

The Pacific figures show the activities of the great Lick and Mt. Wilson observatories in astronomy; and the Middle West has an exceptional representation in mathematics.

A number of the papers which have appeared in the *Proceedings* were read before the Academy at its autumn meeting and have therefore appeared in abstract in Science. Without making exceptions in the case of these papers, the contents of the first four issues of the *Proceedings* may be outlined as follows:

Astronomy.—An analysis of the radial velocities of nebulæ by W. W. Campbell shows that the planetary nebulæ are on the average moving much faster than the helium stars, which are supposed to be nearest to the nebular condition; and this leads to the suggestion that these nebulæ may have arisen by the collision of fast moving stars with resisting media.

H. D. Curtis, from a study of photographs of nebulæ taken at various times throughout a period of thirteen years, concludes that there are upon the plates no evidences of internal motion and little if any of proper motion, indicating great distance and enormous size for these objects.

The announcement of the discovery of the ninth satellite of Jupiter is made by S. B. Nicholson.

R. E. Wilson reports abnormally high radial velocities (some 250 km. per sec.) for nebulæ in the Magellanic Clouds, and calls attention to the importance of determining the velocities of stars in the clouds to ascertain whether the clouds as a whole may have such a velocity.

Kapteyn's theory that the universe is mainly composed of two great streams of stars is strongly supported by a statistical study of stellar radial velocities by J. C. Kapteyn and W. S. Adams. New observations of faint stars show that the streams extend to the greatest distances for which data are available.

A. van Maanen's measures of stellar parallaxes with the sixty-inch reflector are apparently of very high precision.

Solar physics is represented by a number of contributions. G. E. Hale and H. D. Babcock seek with the aid of the Stark effect to measure the potential-gradient in the solar atmosphere, and find that at the level in question it does not exceed two hundred times the average value in the earth's atmosphere. A study of the flash spectrum of the uneclipsed sun leads W. S. Adams and E. G. Burwell to infer that the observations without an eclipse represented a lower level than those during eclipse, and that there is a considerable gain in accuracy (owing to the greater linear scale of the Mt. Wilson photographs); the results do not support the hypothesis of anomalous dispersion as explanatory of solar phenomena. C. E. St. John offers an extensive critique of this hypothesis, and concludes that the theory which bases the shifts in the spectral lines on supposed velocities in the solar atmosphere is far more satisfactory than that which explains these shifts by anomalous dispersion.

That spherical aberration may be induced in a thoroughly corrected objective by rapidly changing temperatures is noted by F. Schlesinger, and mechanical devices for removing the inequalities of temperature are described.

C. E. St. John and H. D. Babcock have examined the spectral lines in the iron arc and have discovered that the wave-lengths of many of the lines depend upon the portion of the arc from which the light is taken, a fact which must be recognized in fixing precise standards in spectroscopy.

Chemistry.—Revisions of the atomic weights of cadmium, lead and praseodymium are reported by G. P. Baxter and various collaborators. The values obtained are: cadmium, 112.417; lead, 207.20; praseodymium, 140.92; Cl = 35.457 and Ag = 107.880 being assumed in the computations. There appeared to be no difference between specimens of lead from different geographical sources.

W. A. Jacobs and M. Heidelberger offer a proof of Dimroth's monomolecular formulas for *p*-aminophenylmercuric compounds as against Pesci's more complicated formulas.

P. A. Levene and F. B. La Forge state that the 2-aminohexose isolated by them and named chrondrosamine has the configuration of either 2-altrosamine or of 2-allosamine.

In a series of papers on potassium ammono argentate, barate, calciate, and sodate, on metallic salts of ammono acids, and on ammonobasic iodides of aluminium, E. C. Franklin reports further progress on his extensive investigation on the analogies between aqueous and liquid-ammonia solutions.

The use of J. J. Thomson's electron theory of valence and of various modifications of that theory is discussed by J. Stieglitz, both descriptively and (with collaborators) experimentally, in papers on the molecular rearrangements of triphenylmethane derivatives with the conclusion that the original Thomson theory is extremely useful, but that its newer modifications are not necessary so far as the present investigation is concerned.

An extended investigation of the effects of lipases in hydrolyzing esters is described by K. G. Falk. He comes to the conclusion that the specific character of these effects is due in some cases to the influence of the ester on the enzyme in causing its coagulation or precipitation, and in other cases to the influence of the enzyme on the ester arising from the presence in the former of special groupings similar to those in amino-acids and peptides, which also bring about hydrolysis of esters, as shown by the experiments of the author made in collaboration with M. L. Hamlin.

E. W. Washburn and J. W. Read show that the freezing-points and the eutectic point of solutions, however concentrated, of two substances which conform to the laws of ideal solutions can be calculated; and they communicate experiments which show close concordance of the observed eutectic points with those calculated. They derive from their considerations the following quantitative principle relating to solubility: When a crystalline substance *A* is dissolved in any solvent *B* with which it forms an ideal solution, its solubility is independent of the nature of the solvent *B*, and depends merely on the temperature and on the melting-point and heat of fusion of the crystals *A*.

E. W. Washburn and E. B. Millard show that the electrolysis of a solution of cesium

chloride containing raffinose at low concentration is attended by a decrease in the anode-portion, and an increase in the cathode-portion, of the ratio of the quantity of water to that of raffinose. This result proves that there is a net transfer of water to the cathode, and therefore that the cesium ion is hydrated to a greater extent than the chloride ion. The cesium ion is shown to be the least hydrated of the ions of all the alkali elements previously studied.

Geology.—A voyage through the Pacific to visit coral reefs for the purpose of discriminating between various theories proposed to account for their formation convinced W. M. Davis that Darwin's original theory of subsidence gives by far the most satisfactory explanation of all the barrier reefs he visited.

G. F. Becker proposes to consider the earth as a heat engine competent to bring about all the dynamical effects with which geology has to deal by the stress and strains which would arise during cooling, due to local differences of the tendency of the surface layer to lose heat.

Paleontology.—The hypothesis advanced by C. D. Walcott that bacteria probably were an important factor in the deposition of the Algonkian limestones has received strong support by his discovery of bacteria resembling Micrococci in the fossil alga of the Newland limestone.

Botany.—C. J. Chamberlain presents a phylogenetic study of Cycads based upon detailed field-work extending over a decade.

Phoradendron is classified by W. Trelease into two primary groups: Boreales containing 60 and Æquateriales containing 202 differentiable forms, most of which he regards as species.

From a study of the morphology and relationships of *Podomitrium malaccense* D. H. Campbell decided that *Podomitrium* is much more like *Blyttia* than like *Metzgeria* and should be placed in the Blyttiaceæ rather than Aneuraceæ.

That the loss of viability in seeds with storage is a matter of coagulation of cell proteins, and that there is a possibility of determining a quantitative statement of the significance of various storage conditions, is indicated by a study of the germination of wheat by W. Crocker and J. F. Groves.

Zoology.—Experiments on the fertilizing power of sperm dilutions of *Arbacia* indicate to F. R. Lillie that the loss of fertilizing power is due not to loss of motility of the spermatozoa, but to loss of their activating substance, which he designates as sperm receptors; light is also thereby thrown on the process of fertilization.

C. Zeleny and E. C. Faust investigate dimorphism in size of spermatozoa with its relation to the chromosomes, and come to the conclusion that such dimorphism must exist very generally and is probably the result of chromosomal dimorphism present in the spermatids.

R. Goldschmidt reports experiments which point to the probability that the general processes of spermatogenesis are necessary reactions of the cells to a systematic regulation of the osmotic conditions on the part of the follicular membrane; the individual specific processes are caused by the specific properties of the reacting cells.

Extensive experiments on flounders show that their remarkable ability to simulate the color and pattern of the background against which they rest is controlled by their visual perception of the background and that the rapidity of the adaptation to surroundings is greatly increased by frequent practise, according to S. O. Mast.

A quantitative ecological study of the Madreporian corals of the fringing reef of Maer Island is presented by A. G. Mayer; the destructive effects of temperature, silt, etc., are discussed.

Genetics.—C. B. Davenport has two articles upon the feebly inhibited: I. Violent temper and its inheritance; II. Nomadism or the wandering impulse with special reference to heredity. The nomadic instinct is fundamental in man, but is inhibited in well-regulated individuals. The tendency to outbursts of temper is probably a dominant trait.

By studying quantitatively the color patterns of a race of rabbits bred especially for the purpose W. E. Castle and P. B. Hadley obtain what they regard as conclusive evidence

against the idea of unit-character constancy or "gametic purity."

Experiments on self-sterility incline E. M. East away from simple Mendelian formulas of the type suggested by Correns and toward Jost's idea of "Individual stoffe" and a near-Mendelian interpretation.

In an attempt to analyze the normal variation of an organism from the standpoint of *Entwicklungsmechanik,* R. Pearl and F. M. Surface study growth and variation in maize. They find that the differences in the manner of growth of individual plants and of groups of plants can not be explained as the effect of environmental factors, but should be regarded as due to internal factors; they regard the differences as due to independent Mendelian factors distributed at random in any population of open fertilized maize plants.

Bacteriology.—W. A. Jacobs and M. Heidelberger report upon a new group of bactericidal substances obtained from hexamethylenetetramine.

In experiments upon *B. coli,* E. O. Jordan finds an instance of bacterial mutation which seems to fulfil the requirements of appearing suddenly without intermediate stages, of being irreversible, of comprising change of two characters, and of not involving all of the cells of the parent strain.

Physiology.—In a series of short notes F. G. Benedict (with collaborators) sets forth these results: The gaseous metabolic processes of vegetarians are qualitatively and quantitatively essentially those of non-vegetarians of similar height and weight. There is a distinct tendency for athletes to have a measurably larger basal resting metabolism than non-athletes. Men disclose a basal metabolism some 5 or 6 per cent. greater than women of similar height and weight. The general conclusion is that the basal metabolism of an individual is a function, first, of the total mass of active protoplasmic tissue, and second, of the stimulus to cellular activity, existing at the time the measurements are made. The 416-page monograph containing chemical and physiological studies of a man fasting thirty-one days, recently published by the Carnegie Institution, is represented in the *Proceedings* by a chart indicating the trend of the most important factors measured.

An exposition of a dynamic conception of the organic individual is given by C. M. Child in terms of metabolic gradients. The region of high metabolic rate determining the gradient arises from the differential action of factors external to the organism and becomes the chief determinant of the rate in near-by regions, thus finally dominating the whole individual and affording a basis for the orderly development of the whole which is observed throughout nature.

According to S. Tashiro the nerve impulse is a propagation of chemical change, a propagation due to restoration of an equilibrium disturbed by the increase of metabolism at the point of stimulus and proceeding toward the point where there is less chemical activity as measured by production of carbon dioxide.

J. Loeb and H. Wasteneys find that heliotropism in animals and plants is essentially the same.

Anthropology.—Caribou and related types of culture among the Indians and the diffusion of horse culture among them are treated in two articles by C. Wissler.

A. C. Fletcher reports upon her studies of Indian music.

An examination of Barbados convinces J. W. Fewkes that Barbados had in prehistoric times a large local population whose culture resembled that on the other West Indies.

A. Hrdlička gives an account of the anthropological expeditions sent out to collect material for the exposition at San Diego.

Psychology.—An outline of a point scale for measuring mental ability, a revision of the Binet scale, is given by R. M. Yerkes. The same author sketches the results of his experiments upon color vision in the ring dove.

Mathematics.—L. E. Dickson offers two papers upon his new modular geometry. Two notes on abstract groups are due to G. A. Miller. Point sets and allied Cremona groups are treated by A. B. Coble, and H. S. White gives an account of his investigation of triad systems. The theory of surface is discussed by E. J. Wilczynski and L. P. Eisenhart, and F. L. Hitchcock submits a classification

of quadratic vector functions. Analysis is represented by a contribution from G. A. Bliss on functions of lines and one from A. Dresden upon the calculus of variations.

Edwin Bidwell Wilson

SPECIAL ARTICLES

A MODIFICATION OF THE BELLANI POROUS PLATE ATMOMETER

A recently renewed and increased interest in the direct measurement of the evaporating power of the air[1] has brought the atmometer (incorrectly called evaporimeter, etc.) into greater prominence than has heretofore been enjoyed by that instrument. Atmometers are now being used more than ever before, especially in plant physiology, plant and animal ecology, and the agricultural aspect of climatology.[2] This newer development of atmometry has emphasized the employment of water-impregnated solids to furnish the evaporating surface from which the rate of evaporation is studied, and has discouraged the use, for many purposes at least, of the open pan or tank of water so commonly met with in meteorological and general climatological literature. It has thus come about that considerable misunderstanding has arisen as to what atmometry is really aiming at and as to the relative desirability of studying evaporation from one or another kind of evaporating surface.

Of all the different forms of water-impregnated surfaces employed in the study of atmospheric evaporating power, the cylindrical porous clay cup of Babinet[3] has met with the most favor among biological and agricultural workers, and the standardized porous cups now in general use follow the principle of Babinet's device. This type of atmometer possesses a number of pronounced advantages over the free water surface, when atmospheric evaporating power is to be studied as an environmental condition affecting animals and plants. Among these advantages may be mentioned the fact that the evaporating surface of the cup projects up into the air like most animal and plant surfaces. Thus it does not so readily become clogged, as it were, by its own vapor blanket, as does a horizontal surface. Furthermore, the porous cup instrument is much more readily and precisely read than is the open tank, and very short time intervals may consequently be employed. I have frequently constructed graphs showing the march of evaporating power by minute or 5-minute rates, a procedure hardly possible with any form of pan atmometer. More important than any other of the advantages here in question, however, is the one depending upon comparative variability of the evaporating surface with

[1] The evaporating power of the air may be thought of as the reciprocal of the resistance offered by the air to evaporation from exposed liquid water. The term is a misnomer to a degree, for evaporation proceeds from a water surface *in spite* of the conditions obtaining in the surrounding air. Ceteris paribus, the greater is the air pressure, the less rapid is evaporation; the less water is contained in the air the more rapid is evaporation, etc. The term has come into rather general use, however, and may as well stand till a better is suggested; it is logically no worse than the word suction, and, like it, is readily understood by everybody. *Condensing* power or *water supplying* power can not here be used in place of *resistance*, because air without water-vapor offers resistance to evaporation but has no condensing power; it can not deposit water upon a surface, no matter what its pressure may be. The resistance offered by such dry air can be expressed in terms of an equivalent condensing power, however.

[2] Livingston, B. E., "The Relation of Desert Plants to Soil Moisture and to Evaporation," Carnegie Inst. Wash. Pub. 50, 1906. Shelford, V. E., "Animal Communities in Temperate America," Geog. Soc. Chicago Bull. 5, 1913, pages 162–65. Livingston, B. E., and L. A. Hawkins, "The Water Relation between Plant and Soil," Carnegie Inst. Wash. Pub. 204, 1915 (the first paper of that publication). Shive, J. W., "An Improved Non-absorbing Porous Cup Atmometer," *Plant World*, 18: 7–10, 1915. Livingston, B. E., "Atmometry and the Porous Cup Atmometer," *Plant World*, 18: 21–30, 51–74, 95–111, 143–149, 1915. Livingston, B. E., "Atmospheric Influence upon Evaporation and Its Direct Measurement," *Mo. Weather Rev.*, 1915. McLean, F. T., "Relation of Climate to Plant Growth in Maryland," *Mo. Weather Rev.*, 1915.

[3] Babinet, J., "Note sur un atmidoscope," *Compt. Rend. Paris*, 27: 529–30, 1848.

reference to wind action. When ripples or waves are formed on a free water surface the surface is very markedly altered, and this kind of alteration occurs so generally and so uncontrollably with pan or tank atmometers exposed in the open, that it renders futile any detailed study of evaporating power carried out with such instruments. Properly cared for and properly operated, the porous cup surface does not appreciably alter, at any rate it is never altered by wind action. Other advantages of the porous cup over the free water surface are related to errors in reading the latter type of atmometer arising from splashing and spray, the removal of water by animals and the capture of animals, wind-blown leaves, etc., in the tank; none of these errors are encountered in the operation of the Babinet atmometer. Also, the porous cup may be so mounted as not to absorb rain, which always plays havoc with readings from open pans.

For certain purposes, however, such as the study of atmospheric evaporating power at or near the soil surface or the surfaces of reservoirs, etc., the porous cylinder is not well suited; here a plane evaporating surface is frequently requisite. The well-known Piche atmometer, or Cantoni's[4] or Houdaille's[5] modification of the latter, all three employing blotting-paper disks, may be used in such cases, but these instruments are less convenient in operation than is the porous cup, in various ways. It therefore seemed desirable to bring into use what amounts to a porous clay cup with a plane evaporating surface. Just such an instrument was devised and described very long ago by Bellani,[6] who appears to deserve credit for first employing a water-impregnated solid connected by a simple water column with a reservoir at a lower level. The principle here involved forms the basis of the Piche-Cantoni and Babinet instruments as afterwards constructed.

It is hard to understand why Bellani's device should have remained unmentioned during nearly a century of climatological and meteorological advance. Especially surprising is this lack of recognition when it is appreciated that this horizontal plate of Bellani is exactly the form of instrument that should have replaced the open pan in the vain struggles of meteorological students to obtain the long-sought "evaporation formula"; thus might have been avoided, perhaps, some of the wasted effort expended in attempts to express by a single term the influence of wind upon evaporation, when the latter was measured from the variously rippled surface of free water.

In Bellani's atmometer, a horizontal porous clay disk closed the top of a vessel completely filled with distilled water, so that the lower surface of the disk was in contact with the liquid, while the upper surface was exposed to the air. A horizontal, graduated glass tube, of small bore, open at its distal end, projected laterally from the vessel, and the air-water meniscus in the tube progressed toward the vessel as evaporation occurred, the tube thus becoming more or less rapidly emptied of water. A suitable reservoir and cock allowed the meniscus to be pushed back over the scale, by admitting more water into the vessel. As water evaporates from the porous surface of such an instrument more is imbibed from below, and air pressure drives the meniscus inward along the scale, keeping the vessel completely filled and the plate continuously in contact with the water below. The instrument may be mounted with a burette reservoir, as is frequent with the porous cups now in use, instead of the horizontal graduated tube.

After some preliminary discouragement I have at length been able to obtain circular

[4] Cantoni, G., "Sulle condizioni di forma e di esposizione piu opportune per gli evaporimetri," *Rend. R. Ist. Lomb.*, II., 12: 941–46, 1879.

[5] Houdaille, F., "Mesure de l'évaporation diurne; description d'un évaporimètre enregistreur," *Bul. Mét. Hérault*, 1890. (This is the instrument catalogued by Richard Frères, Paris. For further references to Houdaille's work, as well as that of others, see: Livingston, Grace J., "An Annotated Bibliography of Evaporation," *Mo. Weather Rev.*, 36: 181–86, 301–06, 375–81, 1908; 37: 68–72, 103–09, 157–60, 193–99, 248–52, 1909. Reprinted, repaged, Washington, 1909. This includes most of the papers appearing before 1908.)

[6] Bellani, A., "Descrizione di un nuovo atmidometro, etc.," *Gior. Fis. Chim.*, 3II: 166–77, 1820. (Reprinted, Pavia, 1820.)

porous clay plates (77 mm.—3 in.—in diameter) mounted across the large end of a glazed porcelain funnel. The apparatus is made as a single piece, the funnel wall and the disk being continuous, and the lateral surface is afterwards heavily glazed externally. The funnel part is nearly hemispherical, with the cylindrical neck projecting outward from the spherical surface, opposite the center of the porous disk which closes the hemisphere at the top. A vertical section of such a piece is shown in Fig. 1. In operation, the opening

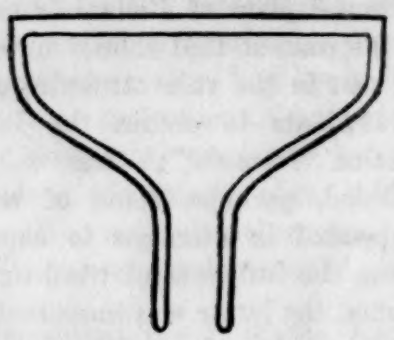

Fig. 1.

is closed by a rubber stopper bearing a tube reaching to the water reservoir below, just as in the case of the ordinary porous cup atmometer. Of course it is not at all essential that the plate be horizontal; it may be exposed in any direction, even downward. All that is necessary is that the water level in the reservoir be at a lower level. It may be mounted on a bottle or a burette, or any convenient form of reservoir, and the non-absorbing mounting may be employed to prevent the absorption of rain. In general, these Bellani plates are to be operated just as are the ordinary porous cups. Where a plane evaporating surface is required, they possess all the advantages of the free water surface and none of its disadvantages. They also possess all the general advantages of the porous cup instrument.

Burton E. Livingston

The Effect of Temperature on the Life Cycle of Musca Domestica and Culex Pipiens

Owing to a scarcity of data necessary to illustrate the relation of the temperature to the rate of breeding of flies and mosquitoes, a set of experiments was undertaken at the suggestion of Professor C.-E. A. Winslow, to determine (approximately) this relation.

These experiments were made possible through the courtesy of the department of natural history of the College of the City of New York in loaning us three incubators for the purpose.

The experiments began late in July, 1914, and ran through to the middle of September.

An effort was made to eliminate all factors but that of temperature.

Individual variations among different batches of eggs were eliminated by dividing the same batch into three portions to be incubated at the three temperatures.

Larvæ reared from the batches of eggs compared were fed on the same food.

The light, throughout, was either diffused or absent, and the same condition obtained in the batches compared with each other.

By exposing several tumblers of water in each incubator, the atmosphere was kept in a high state of saturation.

All vials containing the breeding fly larvæ were of the same cross section and the height of manure was about the same in each, *i. e.*, from 1½ to 2 inches; the mosquito-larvæ vials and infusions were also uniform.

From the above it will be seen, that although the results may not indicate a breeding rate generally true for each temperature, they nevertheless offer a fair comparative study of the rate at the three temperatures.

Experiments with Flies

Experiments with the life cycle of flies will be treated first.

Egg batches were obtained in the following way: Flies were caught by net and females with gorged abdomens selected. These were first placed together in large fruit jars containing rotten fruit (plums), and the jar was

TABLE I

Average Duration of Each Stage—Flies

Temp.	Egg Stage	Larva	Pupa	Total
20°	1.2 da.	12.3 da.	8.8 da.	22.3 da.
30°	1 da.	5.1 da.	4.2 da.	10.3 da.
35°	1 da.	4.3 da.	4.0 da.	9.3 da.

TABLE OF RECORDED RESULTS OF WORK WITH FLIES

Sample.	Temp.	Stages.			Total.
		Egg.	Lar.	Pup.	
A					
	20°	1 da.	14 da.	9 da.	24
	30°	1 da.	7 da.	5 da.	13
	35°	1 da.	Molds		
B					
	20°	1 da.?	13 da.	10 da.	24
	30°	1 da.	7 da.	5 da.	13
	35°	1 da.	6 da.	4 da.	11
C					
	20°	1 and 2 da.	17 da.	5 da.	23
	30°	1 da.	6 da.	4 da.	11
	35°	1 da.	6 da.	4 da.	11
D					
	20°	1 da.	?	?	24*
	30°	1 da.	7 da.	4 da.	12
	35°	Molds			
E					
	20°	1 da.	13 da.	9 da.	23
	30°	Molds			
	35°	1 da.	4 da.	5 da.	10
F					
	20°	1 and 2 da.	13 da.	11 da.	25
	30°	Molds			
	35°	Molds			
G					
	20°	1 da.	?	?	24*
	30°	1 da.	Molds		
	35°	1 da.	Molds		
H					
	20°	1 da.	?	?	23*
	30°	1 da.	5 da.	3 da.	9
	35°	Molds			
I					
	20°				
	30°	Parasitized			
	35°				
J					
	20°	2 da.	8 da.	9 da.	19
	30°	1 da.	4 da.	5 da.	10
	35°	1 da.	4 da.	3 da.	8
K					
	20°	1 da.	8 da.	9 da.	18
	30°	1 da.	3 da.	4 da.	8
	35°	1 da.	3 da.	4 da.	8
L					
	20°	1 da.	15 da.	——	
	30°	1 da.	3 da.	4 da.	8
	35°	1 da.	3 da.	4 da.	8
M					
	20°	1 da.	7 da.	——	
	30°	1 da.	4 da.	4 da.	9
	35°	1 da.			
N					
	20°	1 da.	11 da.	——	
	30°	1 da.	8 da.	——	
	35°				
O					
	20°	1 da.			
	30°	1 da.	5 da.	——	
	35°				

observed from time to time for deposits. This method proved too cumbersome, and another method was later employed, that of isolating two or three gorged females in a 2-oz. vial over a portion of egg-free manure. Manure from the same dropping was used for all vials in each series.

As egg batches were deposited their removal followed as soon as they were observed.

Each batch was divided into three parts, and the eggs placed in vials on about an inch and a half of egg-free manure and incubated at 20°, 30° and 35° C., respectively.

The manure was examined twice daily, morning and afternoon, by carefully stirring up the manure, and any changes were recorded. Records were made under the following heads: Date of incubation; date of appearance of larvæ; date of appearance of pupæ; date of appearance of adult.

The first series of experiments was greatly hampered by fluctuation in temperatures of the incubators and by the appearance of molds in the fly cultures which in almost all cases prevented the completion of the life cycle. These first experiments are omitted and only those broods that came through without mishap or nearly so are recorded.

The accompanying table gives the average periods for each stage at the three temperatures. (Complete data are appended.)

EXPERIMENTS WITH MOSQUITOES

Batches of eggs were collected every morning from a rain barrel and each batch was divided into three portions, and each portion placed in a 2-oz. vial on the surface of a manure infusion. The manure infusion was selected from a series of tested media since it proved a most satisfactory medium for the larvæ and pupæ. About 1½ grams of manure were added to 40 c.c. of tap water. The vials were incubated at 20° C., room temperature, and 30°, respectively; 35° proved fatal to these insects in most cases. The vials at room temperature were kept out of air currents by placing them in a box. This precaution, however, did not prevent an evening drop in temperature of 5 to 8 degrees, but on the whole the room tempera-

ture was between the two incubator temperatures.

The following table gives the average length of period of each stage:

TABLE II

Average Duration of Each Stage—Mosquitoes

Temp.	Egg Stage	Larva Stage	Pupa Stage	Total
20°	2	14	3.6	19.6
R	1	7.7	3.0	11.7
30°	1	4.8	2.0	7.8

TABLE OF RESULTS OF WORK WITH MOSQUITOES

Sample	Temp.	Stage			Total
		Egg s) (in Day	Larv. (in Days)	Pup. (in Days)	
1					
	20°	2	16	3	21
	R	1	6–8	3	10–12
	30°	1	6		
2					
	20°	2	16	3	21
	R	1	8	3	12
	30°	1	5	2	8
3					
	20°	2			
	R	1		3	12
	30°	1		2	7
4					
	20°	2			
	R	1		4	12
	30°	1		2	7
5					
	20°	2	16	3	21
	R	2	9	2	13
	30°				
6					
	20°	2	13	5	20
	R	1	7	3	11
	30°	1	5	2	8
7					
	20°	2		4	15
	R	1			
	30°	1		2	9

DISCUSSION

A study of Tables I. and II. brings to mind the interesting results of Snyder on the rate of heart beat of the tortoise heart. He found that between temperatures 5° and 30° C., the number of heart beats is doubled to trebled for every rise of 10° C. temperature.

SNYDER'S RESULTS ON THE RELATION OF TEMPERATURE TO THE RATE OF HEART BEAT

Time. Minutes	$T=10°$		$T=20°$		$T=30°$	
	Heart 1	Heart 2	Heart 3	Heart 4	Heart 5	Heart 6
5	9.5	9.5	21.5	21	48	48
10	7	9	21	24	48	44
15	6.7	8.7	19	18	48	40
20	7	8.2	19	16.5	41	
30	7	7	16	14		
40	6.5	7.9	15.5	15.5		
50	6.5	7.9	13.5	16		
60	6.2	7.4	13	15		
80	6.2	6.8	11	14.5		
100	6.5	7.1	10	10		
120	6.4	6.6	8	10		
140	6.5	6	8	9		
160	6.5	5.9	7.6	9		

These results agree with the work of Clausen (reference 2, below) on the amount of CO_2 produced by 100 gr. seeds of lupines in one hour at different temperatures.

CLAUSEN'S RESULTS ON THE RELATION OF TEMPERATURE TO THE AMOUNT OF CO_2 PRODUCED

Temperature	CO_2 Produced
0°	7.27
5°	13.86
10°	18.11
15°	34.37
20°	43.55
25°	58.76
30°	85.00
35°	100.00
40°	115.90
45°	104.45
50°	46.20
55°	17.70

Both the above tables as well as my own show a general agreement with the chemical-physical law of van't Hoff and Arrhenius (reference 2, below) which states that the velocity of chemical reactions is raised to between two and three times its original amount, whenever the temperature advances 10° C.

The more recent work of E. D. Sanderson and L. M. Peairs indicates this same relation of temperature to insect life.

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S. D. KRAMER
AMERICAN MUSEUM OF NATURAL HISTORY

SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 540th meeting of the society was held in the Assembly Hall of the Cosmos Club, Saturday, April 17, 1915, called to order by Vice-president Rose at 8 P.M., with 50 persons present.

Under the heading Brief Notes, Dr. L. O. Howard called attention to the development of mosquito larvæ and adults in pools of water formed by melting snow in the mountains of New York state, the eggs having been laid on the ground the previous summer in places where pools would be formed.

The first paper of the regular program was by J. D. Hood, ''Some Features in the Morphology of the Insect Order Thysanoptera.'' Mr. Hood gave a general account of the Thysanoptera, called attention to the large amount of systematic work that had been done in it during recent years, and said that it was estimated that about 25,000 forms would be found to exist in the order. He called particular attention to the structure and mechanics of the foot, and to the asymmetrical mouth parts, illustrating the peculiarities of each by diagrams. Mr. Hood's paper was discussed by Dr. Howard.

The second paper of the regular program was by Mr. E. A. Goldman, ''Biological Explorations in Eastern Panama.'' Mr. Goldman gave an account of his work in connection with the Smithsonian Biological Survey of the Panama Canal Zone, in 1912, in extreme eastern Panama, with a view to determining the faunal relations of that section to the Canal Zone and to western Panama. Very little zoological collecting had previously been done in the region which was scarcely better known than in the sixteenth century, at the time of the Conquest.

The region proved to be mainly southern American in faunal characters, with a slight admixture of north and middle American elements. Many South American species apparently reach their northern limits here. The collections of birds and mammals have been identified, and about forty of the mammals and thirty of the birds have been described as new. Among the birds are three new genera, two of them of humming birds. No new genera of mammals were taken, but several had not previously been reported from Panama. A new species of *Capybara* was among the more notable mammals. Spiny rats of the genus *Proechimys* were found common. The tail, normally long in this animal, is lost through some pathological condition in many individuals, and owing to this circumstance the natives believe in the existence of two species.

Mr. Goldman's paper was illustrated by lantern slide views of the country explored, and of objects pertaining to its natural history. It was discussed by Messrs. Wetmore and Lyon.

The third and last paper of the program was by Vernon Bailey, ''Notes on Variation Distribution and Habits of the Pocket-Gophers of the Genus *Thomomys*.'' Mr. Bailey said these rodents constituting a genus of the peculiar American family Geomyidæ are distributed over the western United States extending from Alberta and British Columbia to southern Mexico. They range from the Arctic Alpine to the Tropical zonal areas and are generally abundant in the regions they inhabit. They are burrowers, live almost entirely underground and are probably more restricted in their individual habitats than any other of our native mammals. This to some extent accounts for their great range of variation and the large number of recognizable forms, nearly ninety. Almost every change in climate, soil and environment is reflected by some change in the color, size, proportions, or cranial characters. There is wonderful adaptation in their color to that of the soil inhabited by them, varying from creamy white on the light sands of the lower Colorado River flats to dark browns on the volcanic plateaus of Mexico and Arizona, and almost black along the humid Pacific coast region of northwestern California. There is also a pure black form on the coast of Oregon which may be an extreme case of dichromatism, as there are several species with a well-marked black phase.

Their habit of burrowing enables the gophers to escape many enemies and to adapt themselves to rigorous climatic conditions. In the past this

habit was useful in keeping the soil upturned and "ploughed," but under artificial cultivation by man this habit renders the animals a pest. They are very destructive to root crops, clover, alfalfa and grain. By cutting roots they often do much damage to orchards, nurseries and vineyards. They may be destroyed by trapping or on a large scale by placing poisoned food in their burrows. In a revision of the genus just submitted for publication as a number of the *North American Fauna* a general discussion of the habits is given as well as descriptions of species and subspecies, and maps showing distribution.

Mr. Bailey's communication was illustrated by lantern slides from photographs of living animals and of their work.

Messrs. Cooke, Wilcox, Howard and others took part in the discussion.

THE 541st meeting of the society was held in the Assembly Hall of the Cosmos Club, Saturday, May 1, 1915, called to order by Vice-president Rose at 8 P.M., with twenty-six persons present.

On recommendation of the council, Admiral G. W. Baird was elected to active membership.

Under the heading of Brief Notes and Exhibition of Specimens, Dr. O. P. Hay made remarks on the extinct ground sloths of America and called attention to the existence of a specimen of *Nothrotherium* from the North American Pleistocene, in Baylor University, Texas. Mr. Wm. Palmer announced that he had lately seen an apparently wild specimen of the European skylark in near-by Virginia. He also exhibited the jaws of a ray, *Rhinoptera bonasus,* collected at Chesapeake Beach, Maryland. Mr. E. W. Nelson called attention to the newspaper notoriety attained by the San Antonio (Texas) bat roost erected under the misconception that bats were destructive to mosquitoes. He said there was no evidence that the species of bats (*Nyctinomus mexicanus*) in these roosts consumed mosquitoes, and that they foraged so far from these roosts that there would be little likelihood of their consuming insects in the vicinity of San Antonio.

The first communication of the regular program was by C. W. Gilmore, "Observations on New Dinosaurian Reptiles."

The speaker discussed briefly some of the more important discoveries of dinosaurian fossils made in North America during the past two or three years, referring especially to the explorations conducted by the American Museum of Natural History and Canadian Geological Survey in the Edmonton and Belly River formations in the Province of Alberta, Canada. He stated that the recent finding of several specimens with which was preserved impressions of considerable parts of the epidermal covering, leads us to hope that the time is not far distant when the external appearance of these animals will be as well known as is the internal skeleton.

Lantern slides of many of the more striking specimens were shown, the speaker confining himself to brief explanatory remarks regarding their systematic position and their more striking characteristics. The following forms were discussed, *Saurolophus* and *Corthyosaurus* of the Trachodont dinosaurs; *Ankylosaurus,* an armored reptile; *Monoclonius, Anchiceratops, Ceratops, Styracosaurus* and *Brachyceratops,* all of the Ceratopsia or horned dinosaurs. In conclusion, life restorations of *Brachyceratops, Thescelosaurus* and *Stegosaurus* modeled by the speaker were exhibited for the first time.

Mr. Gilmore's communication was discussed by Messrs. O. P. Hay, Nelson and Lyon.

The second communication was by William Palmer, "The Basic Facts of Bird Coloration."

The complex and varied coloration of birds was explained as due to several causes, which were grouped as pigmental, structural, chemical and a mixture of two of these. The basic pigmentation was considered as composed of blackish, reddish and yellowish cells, the latter being much subdued and principally diluting the others. This coloration group was classed as physiological, in contradistinction to all other tints, colors and glossiness, which were considered as psychological results due to semi-consciousness, especially to eyesight, food and certain phases of light.

This arrangement was based on the experience of the speaker on the forest slopes of Mt. Gede, in western Java, where it was found that non-glossy, dark and dingy colored birds were confined almost entirely to a habitat of damp, dense ground-cover vegetation, while those clothed in more or less brilliant colors were inhabitants of the intermediate areas above the ground cover and below the dense canopy of the branches of the tall forest growth.

In the tops of the forest trees a different type of coloration was evident; glossy blacks, whites and grays, were exclusively characteristic, or predominant. These types of coloration were continued down into the lowlands in the same order, but with different species or genera, and with the tree-top type spreading through the more open

and drier areas of the lowlands to near and on the ground.

Less definite intermediate areas between the ground cover and the tree tops, less dense, or with a different vegetation, were shown to be habitats of birds largely green or yellow, the result being that given the general and special coloration of a bird its habitat could be largely or clearly indicated, apparent exceptions having been greatly influenced by other factors.

A correlation was made of these distributional results with the birds of eastern North America, which were considered as governed by the same influences, though forest changes have in modern times greatly complicated the question.

The coloration of other animals is governed by the same laws with similar results, so that where white, glossy black, bright and highly colored areas exist on animals, it is due to psychological progressive adaptations, based on a less complex and simpler dull coloration to be considered as basic, primitive, and thus more purely physiological in contrast.

Mr. Palmer's communication was discussed by Mr. Nelson and Hon. George Shiras, 3d.

M. W. LYON, JR.,
Recording Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

THE one hundred and fourth regular meeting of the Botanical Society of Washington was held in the Assembly Hall of the Cosmos Club at 8 P.M., on Tuesday, April 6, 1915. Forty-five members and fifty-three guests were present. Mr. W. R. Chapline, Jr., was elected to membership. The following scientific program was presented:

Prepaleozoic Algal Deposits: CHARLES D. WALCOTT.

Mr. Walcott described the stratigraphic position of the great Prepaleozoic Beltian series of central Montana, which he considered to be of fresh or brackish water origin. They were deposited in a large inland lake or lakes covering approximately 6,000 square miles of area, also on river flood plains as sand and gravel, or as fine dust carried by the wind. The formations now consist of sandstone, siliceous shales, calcareous shales and beds of limestone, the last varying in thickness from a few inches to several thousand feet. The same type of deposits also occurs in the Grand Canyon region of Arizona, and they extend northward along the main ranges of the Rocky Mountains far into Alberta and British Columbia.

At a horizon approximately 9,000 feet below the base of the Cambrian numerous reefs of algal deposits occur at several horizons in the Newland limestone formation of the Beltian in Montana, and isolated concretionary-like forms occur scattered at various levels in the overlying Spokane shales of the Belt Mountains. The algal remains occur in many forms, some of which are surprisingly similar to those of the fresh-water lake and stream, blue-green algal, deposits of Pennsylvania, New York, Michigan, etc. Others are similar in appearance to the blue-green and green algal deposits of the thermal waters of the Yellowstone National Park.

Mr. Walcott illustrated by lantern slides the various forms of algal deposits as they occur in the Pre-Cambrian rocks and also recent deposits. Photographs of thin sections of both the fossil and recent deposits showed similar chains of cells which are characteristic of the blue-green alga. Other photographs illustrated recent bacteria and those associated with the algal remains in the Prepaleozoic of Montana. These included the Micrococci, with both round and oval cells. Some of the sections appear to carry rodlike bacilli.

The Algal Flora of Some Eocene Oil Shales: CHARLES A. DAVIS.

Extensive beds of petroleum-yielding shales of Eocene age occur in northwestern Colorado and westward. They are carbonaceous, and when fresh are dark brown, hard, tough and compact, with a bituminous odor. So far as observed, they contain no free oil, but yield petroleum on distillation.

By modifying methods of sectioning employed by various investigators in studying coals, the author successfully sectioned these shales by microtome. The sections show an organic detrital magma containing an extensive microscopic flora, which includes a large number of perfectly preserved micro-algæ related to blue-green and higher types.

Thirty-five lantern slides showed the various algæ found in these shales.

Algæ in the Upper Paleozoic: DAVID WHITE.

PERLEY SPAULDING,
Corresponding Secretary

ANTHROPOLOGICAL SOCIETY OF WASHINGTON

AT the 484th meeting of the society, held March 2, Mr. E. T. Williams, of the Department

of State, read a paper on "Confucianism." It existed before Confucius was born but was called by his name because its sacred books were in large part edited by him and he is now one of the chief objects of worship in the system. Confucianism is not merely a system of ethics, as an elaborate description of its rites and sacrifices showed. In 1907 the Empress Dowager raised Confucius to equal rank with the Supreme Deity in the pantheon. President Yuan Shih-kai participated last September in the worship of Confucius at the temple in Peking and offered sacrifice to Shangti in the Temple of Heaven. Ancestor worship prescribed by Confucianism is kept up in private life but Buddhism also is popular in its modified form, which offers immortality in the "Western Heaven." Freedom of worship is claimed in China.

DANIEL FOLKMAR,
Secretary

THE NEW ORLEANS ACADEMY OF SCIENCES

THE regular monthly meeting of the academy was held on Tuesday, April 19, at Tulane University. The president, Dr. Gustav Mann, in the chair and thirty-two members and fellows present. The first paper of the evening was read by Professor Hugh Mercer Blain, of Louisiana State University, "The Old South in Humorous Sketch and Story." Following Professor Blain's paper were two short papers, the first by Dr. J. H. Clo, "A New Form of Conductivity Bridge." A description of a direct-reading device for measuring the electrical conductivity of conductors between the limits 10^{+3} and 10^{-8} with a modification by which the instrument may become an ohmmeter of wide range. The second was by Dr. F. P. Chillingworth, "Some Notes on the Mechanism of the Heart," illustrated by an original model devised by the speaker. All three papers were the subject of discussion.

R. S. COCKS,
Secretary

THE AMERICAN PHILOSOPHICAL SOCIETY

AT the meeting of the society held on May 7, the following paper was read:

Oil Concentration of Ores: HOWARD W. DUBOIS.

Oil has recently been found to be very efficient in the concentration of ores of the base metals, especially copper and zinc. Many of the largest mining companies are adopting this process where water concentration methods have given an unsatisfactory recovery due to the metals having a specific gravity similar to the gangue.

The exact action of the oil is rather imperfectly understood, as the exceedingly small quantities (less than 1/10 of one per cent. in some cases) employed have a concentrating action quite disproportionate to the quantities of oil used. In brief, the concentration seems to be due to the selective action developed by the oil, which coats the metallic particles with a thin film forming an attractive medium for the attachment of gas bubbles produced in the process. These bubbles act like so many life preservers, causing the metallic particles to float on the surface and are collected continuously. The gangue is precipitated through the mass of the oil-water mixture and is drawn off continuously. Some ores which would only give a 50-per-cent. extraction by the standard water concentration methods have given a recovery as high as 93 per cent., by the oil process.

The process is a very cheap one and can be applied to a great variety of ores. The courts have declared that the process is open for use without royalty obligations. The installations already made indicate that it will revolutionize concentrating methods for the base metals and will play the same part in cheapening the extraction of the base metals as the cyanide process has in the case of the precious metals.

THE INDIANA ACADEMY OF SCIENCES

THE Indiana Academy of Sciences met at Bloomington, Ind., on Thursday, Friday and Saturday, May 20, 21 and 22. On Friday evening Professor Foley, of the physics department of Indiana University, gave a lecture on "Electrical Discharges," which was illustrated by about fifty experiments. A "smoker" followed the lecture. On Friday morning fifty members tramped to the reservoir belonging to the university, making a study of the geology and botany of the region en route, and at noon a picnic luncheon was served by the local members. On Friday afternoon automobiles were provided and the party visited a number of the limestone quarries and stone mills of the district. Many interesting operations were witnessed, among them the diamond sawing and the turning of limestone. On Friday evening the Bloomington members of the academy gave a banquet to the visiting members. On Saturday morning a number of members visited the cave region near Mitchell, Ind. The fall meeting of the academy is to take place at Indianapolis early in December.

F. B. WADE,
Press Secretary